PROCEEDINGS OF THE CALIFORNIA ACADEMY OF SCIENCES

Volume 54, No. 24, pp. 407–462, 80 figs. November 14, 2003

The Dangerously Venomous Snakes of Myanmar
Illustrated Checklist with Keys

Alan E. Leviton[1], Guinevere O.U. Wogan[1], Michelle S. Koo[1], George R. Zug[2], Rhonda S. Lucas[1], and Jens V. Vindum[1]

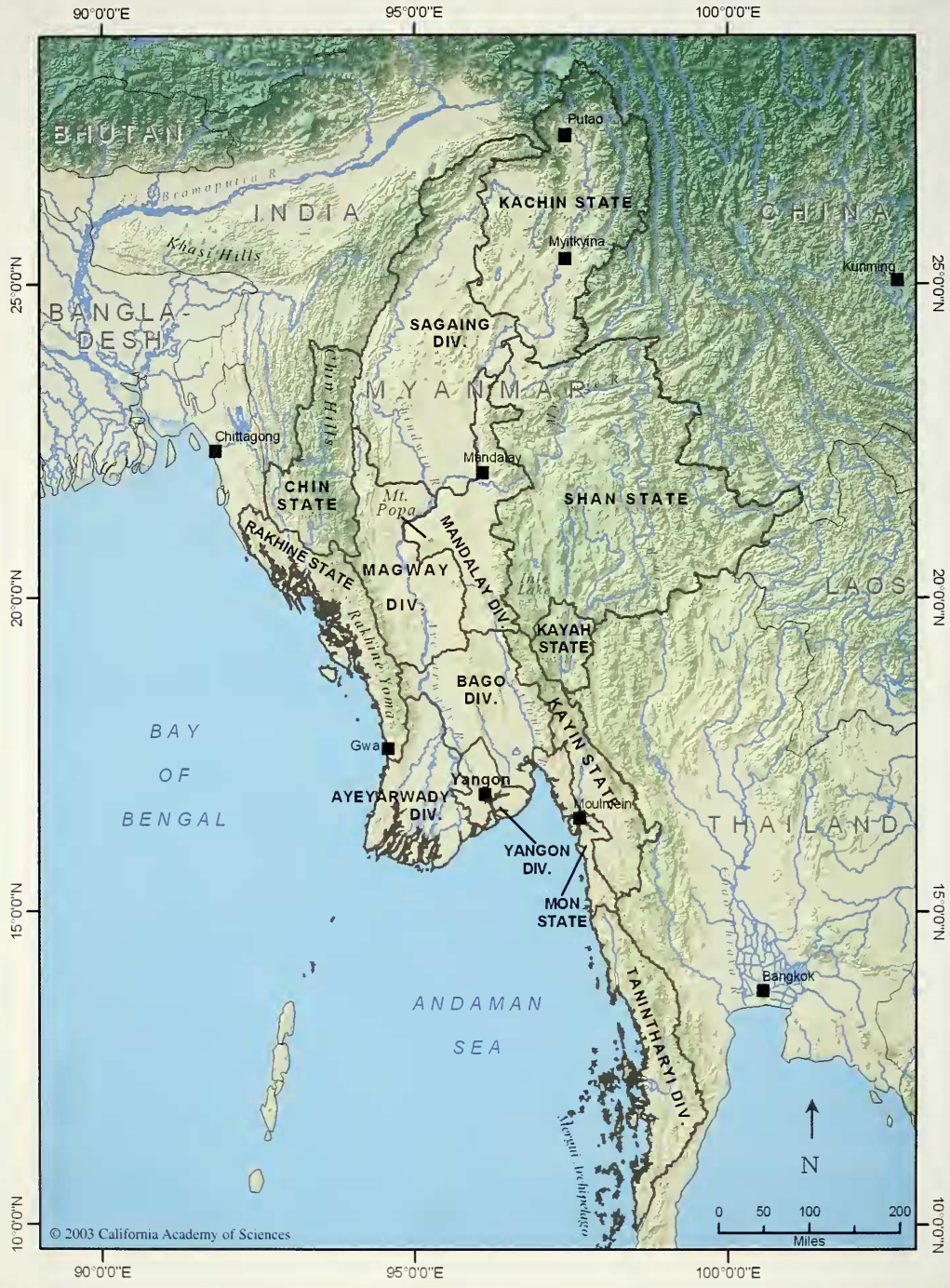
[1] *California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118*;
[2] *National Museum of Natural History, Smithsonian Institution, Washington, DC 20560*

No fewer than 39 species of dangerously venomous snakes are currently known to inhabit Myanmar and the adjacent coastal waters. Of these, 15 are sea snakes and except for two, *Laticauda colubrina* and *Laticauda laticauda*, none voluntarily come onto land (occasionally, obligate marine species may be carried onto shore during severe weather by wave action or enter river deltas in brackish water). Of the remaining 24 species, all are terrestrial in the sense that none voluntarily enters coastal waters. And, of the terrestrial forms, several, such as *Trimeresurus albolabris*, favor arboreal habitats and are usually found resting on tree limbs. All of the terrestrial species can swim, and some are occasionally found swimming in the rivers and streams as well as in flooded rice paddies.

Two families of dangerously venomous snakes are represented in the Myanmar herpetofauna: Elapidae (cobras, kraits, and coral snakes [subfamily Elapinae], and sea snakes and Australian elapids [subfamily Hydrophiinae]), and Viperidae (true vipers [subfamily Viperinae], pitvipers [subfamily Crotalinae], and *Azemiops* [subfamily Azemiopinae]). Known mildly venomous snakes found there, mostly referred to the very large snake family Colubridae, include the rear-fanged snakes of the Asian vine or whip snake genus *Ahaetulla,* the cat-eyed snakes (genus *Boiga*), the genus *Psammodynastes*, and the aquatic and semi-aquatic snakes of the genera *Enhydris, Cerberus, Cantoria, Fordonia*, and *Bitia.* How dangerous any of these are to humans is still an open matter for research. In a like manner, several of the supposedly nonvenomous colubrids have been shown to have toxic salivas and some should be considered mildly if not dangerously venomous. Among these are members of the genera *Xenochrophis, Amphiesma*, and *Rhabdophis*. What we do know is that we often underestimate the severity of many snakebites of both juvenile dangerously venomous and supposedly non-dangerously venomous snakes. Yet, bites of just such animals have been implicated in the deaths of several well-known and knowledgeable professional herpetologists, notably Karl Patterson Schmidt who, in 1957, at the age of 67, was bitten by a juvenile boomslang (*Dispholidus typus*), an African rear-fanged snake, and died one day later, Fred Shannon, M.D., who, in 1965, was bitten by *Crotalus scutellatus*, and died shortly thereafter, Robert Mertens, who was bitten by the African rear-fanged snake, *Thelotornis capensis*, in 1975, and most recently, Joseph Slowinski, who at the age of 38 was bitten by a 30-cm long juvenile krait, *Bungarus* sp.[3], and died within 48 hours. (See Appendix A for comments relating to procedures for handling venomous snakebites in Myanmar.)

Needless to say, care should always be exercised when handling any snake, even those that are supposedly nonvenomous. And, it must be remembered, it is often difficult to distinguish venomous and nonvenomous species without careful inspection. In Myanmar, for instance, several

[3] Ulrich Kuch (Universität Frankfurt) believes that the specimen, although closely resembling *Bungarus wanghaotingi*, represents a distinct species, which he is in the process of describing (see also remarks under *Bungarus wanghaotingi*).



Topographic and political map of Myanmar

snakes are black with white bandings; among these are *Lycodon zawi, Lycodon fasciatus, Dinodon septentrionalis, Bungarus wanghaotingi*, and *Bungarus flaviceps*. The first three are nonvenomous, the latter two dangerously venomous. Although the five can be told apart fairly readily on the basis of color patterns, once one knows the differences, yet, the only sure way to know whether the snake is a venomous or nonvenomous species is to look at the side of the head just in front of the eye to determine if a loreal scale is present or not. In the illustrated keys that follow, these and other defining characters are clearly noted.

The varied topography and associated ecozones of Myanmar (see Maps p. 408 and 458) support a highly diverse herpetofauna, and we are just now beginning to learn how rich in species it really is. The country has not been carefully studied for many years, and it is a credit to the government of Myanmar and especially to the past and present directors of the Nature and Wildlife Conservation Division, Forest Department, U Uga and U Khin Maung Zaw, that intensive surveys are being conducted throughout the country. Already, significant results have been achieved. Shortly before his death, Joseph Slowinski and his colleague Wolfgang Wüster determined that a hooded cobra found in the Mandalay region represented a distinct species, which they named *Naja mandalayensis*. The importance of this can be quickly appreciated when it is understood that to treat snakebites one most often uses species-specific antivenoms, species-specific in that the antivenom used to treat one kind of snakebite usually will not work for the bites of other species. In Myanmar, for instance, only *Naja kaouthia* antivenom is available for cobra bites. Whether this species-specific antivenom works for other cobra snakebites is unknown. Inasmuch as *N. mandalayensis* was only recently recognized as distinct from *N. kaouthia*, there is no way of telling how many people, bitten by *N. mandalayensis* but treated with *N. kaouthia* antivenom, died but could have been saved had more been known about the species diversity and had the proper antivenom been available. Thus, it is hoped that this contribution will enable those engaged in the study of the fauna in the field and the laboratory to recognize more readily the most dangerous as well as interesting components of that fauna.

In the following checklist, we have made no attempt to provide inclusive synonymies. They are available in the works we do cite, namely, Smith (1926 and 1943), Golay et al., especially the sections by McCarthy and by Toribe (1993), Bauer (1998), McDiarmid, Campbell and Touré (1999) and David and Ineich (1999). Where necessary, we do provide additional references. In the statements on distribution, again we have kept them brief, confining ourselves to country for non-Myanmar localities and, where known, to State or Division within Myanmar.

With respect to species names, we have accepted names for several of the dangerously venomously snakes in Myanmar that have not been widely used in the earlier literature. One notable instance is the many-banded krait, *Bungarus wanghaotingi*, formerly *Bungarus multicinctus*. Recent work indicates that the former is both morphologically and geographically distinct from the latter and is the species occurring in Myanmar (but see footnote 3) and the neighboring region of Yunnan Province, China. *Bungarus multicinctus*, in its restricted sense, is known from eastern China, Taiwan, and to the south and west to Laos. In a like manner, we recognize *Trimeresurus yunnanensis* as distinct from *T. stejnegeri* and, tentatively, have removed the latter from the faunal list for Myanmar. David et al. (2001:219) posit that *T. stejnegeri* (*sensu stricto*) may yet be found in eastern and possibly northern Myanmar (*T. stejnegeri* is known from China [including Yunnan Province], Taiwan, Vietnam, and Laos [see David 2001:218]). If so, we suspect that almost certainly it will be found in northeastern Shan State inasmuch as it has been taken in the vicinity of Menglian, in southwestern Yunnan, not far from the border with Myanmar.

A word about treating snakebites. First, all bites should be taken seriously. It is true that a large percentage of the bites, even by dangerously venomous snakes, are what are known as "dry bites,"

that is bites in which no envenomation takes place. But, it is not always possible to know this in advance. So, best take no chances and seek appropriate medical treatment immediately. Following the section on the identification of dangerously venomous snakes, we have appended a brief statement on how best to proceed in the event of a snakebite. Although more complete instructions are available elsewhere and reference to several published articles is given in the bibliography, we have included as Appendix A a brief statement on the treatment of snakebite in Myanmar prepared in 2000 by Dr. Slowinski for use by members of the Myanmar Herpetological Survey field teams.

This publication was prepared initially for distribution within the Nature and Wildlife Conservation Division of the Forest Department, Ministry of Forestry, Myanmar, and specifically to members of the Myanmar Herpetological Survey field team in Myanmar. First written in April 2002, it has been revised to include new data gathered both by the survey's field team and by the authors' reexamination of both specimens and literature. However, there are a number of people in laboratories in Europe and the United States who are actively engaged in research dealing with the viperid genera *Trimeresurus, Ovophis*, and *Protobothrops*, the snakes of the genus *Bungarus*, and the sea snakes, so that the scheme of classification of the venomous snakes as presented here will likely change in the near future.

Acknowledgments

The authors would like to take this opportunity to express their profound appreciation to U Shwe Kyaw, Director General, Forest Department, Ministry of Forestry, and U Khin Maung Zaw, Director of the Division of Nature and Wildlife Conservation, Myanmar, for their ongoing support and encouragement of the Myanmar Herpetological Survey. The survey, initiated by Joseph Bruno Slowinski, Assistant Curator of Herpetology, California Academy of Sciences, in 1998, was initially conceived by U Uga, then Director of the Nature and Wildlife Conservation Division (NWCD). It was with U Uga's encouragement and endorsement that Dr. Slowinski and his colleague, Dr. George R. Zug, Curator of Amphibians and Reptiles at the Smithsonian Institution's National Museum of Natural History, applied for and were granted substantial financial support by the National Science Foundation. The survey was begun in earnest in 1999 at about the same time that U Khin Maung Zaw succeeded U Uga as Director of the NWCD. U Khin Maung Zaw, without hesitation, confirmed his division's confidence in the project. With this support, and with the assignment of several members of the NWCD to the project on a continuing basis, Dr. Slowinski, and other members of the Academy's staff, including Dong Lin, staff photographer, Jens Vindum, Senior Collections Manager in the Department of Herpetology, and two graduate students in Herpetology, Ms. Rhonda Lucas and Ms. Guin Wogan, traveled to Myanmar to conduct field work and, as part of their commitment to the NWCD, to assist in the training of members of its staff in both field and museum techniques.

As noted earlier, in September of 2001, while doing field work in northern Kachin State, Dr. Slowinski was bitten by a krait, *Bungarus* sp., that had just been collected. Because of the field party's isolation, it was not possible to obtain medical help in time and despite valiant efforts to keep him alive, on 12 September 2001, Dr. Slowinski died.

Following the loss of Dr. Slowinski, it was decided by members of the staff of the Academy's Department of Herpetology, again with the encouragement of U Khin Maung Zaw, to continue the project. Thus, we take this opportunity to acknowledge with thanks the contributions that have been and are currently being made to this work by a group of dedicated people both in Myanmar and in the United States: in Myanmar — U Shwe Kyaw, U Khin Maung Zaw, Director of the Division of Nature and Wildlife Conservation; NWCD staff: U Htun Win, Daw Thin Thin, U San Lwin Oo, Sai Wunna Kyi, U Kyi Soe Lwin, U Awan Khwi Shien, and U Hla Tun; in the United States: the late

Joseph Bruno Slowinski, Dong Lin, and Douglas Long. Special thanks must also be accorded U Hla Tun, Dong Lin, Francis Lim, Ashok Captain, Indraneil Das, Nikolai Orlov, and John Tashjian who are responsible for many of the excellent photographs of venomous snakes that are reproduced here. The computer-generated distribution maps were prepared by Michelle S. Koo, the Department of Herpetology's resident Biogeographical Information System Coordinator.

Dr. Indraneil Das, to whom we are indebted for his critical review of the manuscript, also provided us with extensive new information that he has garnered from several sources, including Bauer (1998), McCarthy (1993), Toriba (1993), and his own researches, that either correct or amplify what is known about type localities and the location of holotypes or syntypes of many of the species we deal with here: *Bungarus bungaroides, Bungarus fasciatus, Laticauda colubrina, Laticauda laticaudata, Naja kaouthia, Ophiophagus hannah, Sinomicrurus macclellandi, Enhydrina schistosa, Hydrophis cantoris, Hydrophis fasciatus, Hydrophis gracilis, Hydrophis obscurus, Hydrophis ornatus, Hydrophis spiralis, Hydrophis stricticollis, Kerilia jerdoni, Praescutata viperina, Daboia russelii, Ovophis monticola, Protobothrops jerdonii, Protobothrops mucrosquamatus, Trimeresurus erythrurus, Trimeresurus popeiorum*, and *Trimeresurus stejnegeri*. Dr. Das offered that we could include his data here, but we have chosen not to do so because shortly he will be issuing an updated checklist of Indian reptiles and will include these data in that work. We do want to express our deepest appreciation for his generosity and now look forward, eagerly, to his publication.

At this time we also want to acknowledge ERSI's Conservation Technology Support Program (CTSP) for generously providing both the software and training that have enabled us to prepare the distribution maps that accompany this report.

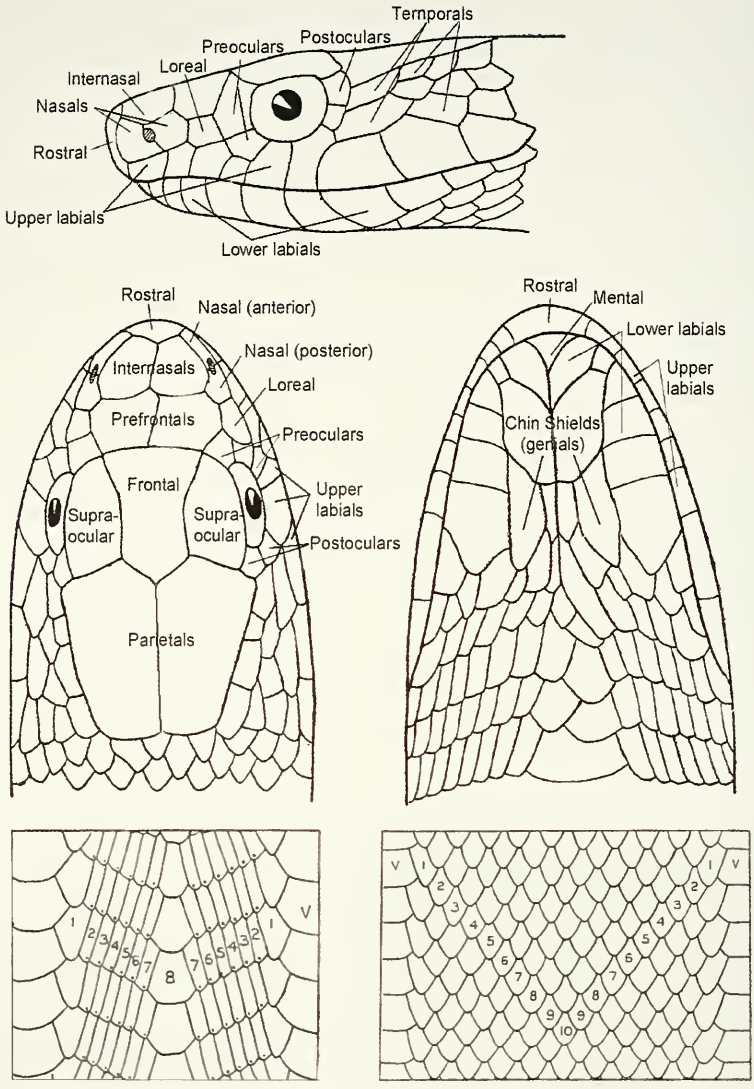
Lastly, we want to express our appreciation to Dr. Michele L. Aldrich who, with her usual editorial acumen, read the manuscript and caught more errors than we wish to acknowledge.

The Myanmar work has been supported by a grant from the National Science Foundation, DEB 9971861. Additional funding has been provided by the California Academy of Sciences' Research Division Inhouse Research and Geraldine K. Lindsay Funds and the Department of Herpetology's Dufflebag Fund.

This contribution is dedicated to the memory of

Dr. Joseph Bruno Slowinski

who lost his life in the pursuit of an understanding of the Myanmar herpetofauna, with special reference to its dangerously venomous snakes.



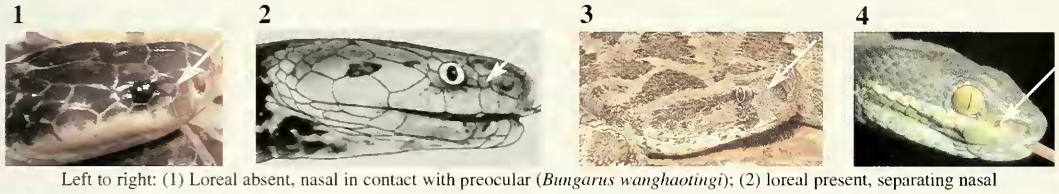
Diagrams of head and body scutellation in a typical snake.
Head shields: (A) Lateral view; (B) Dorsal view; (C) Ventral view
Body scales (numbers indicate best method for counting body scales):
Scales arranged in (A) oblique rows; (B) parallel rows.
(Modified from Smith [1943])

Checklist and Keys to the Dangerously Venomous Snakes of Myanmar

Key to the Genera and Species of Venomous Snakes of Myanmar[1]

1a. Pupil of eye round; loreal scale absent (Fig. 1); poison fangs short, permanently erect; maxillary bone elongate, usually with several small teeth behind the front fangs (Family Elapidae, including cobras, coral snakes, and sea snakes) 2

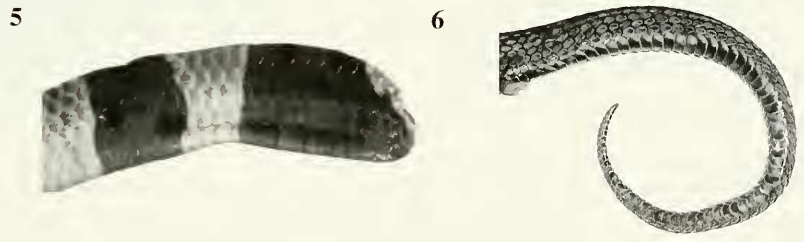
1b. Pupil of eye vertically elliptical; loreal scale present (Fig. 2) or, if absent, then upper surface of head either covered by small scales (Fig. 3) or, if covered by large, symmetrical shields, then a deep sensory pit present immediately behind the nostril (Fig. 4) (also present in many in which the head is covered by small scales); poison fangs variable in length, fixed to a short moveable maxillary bone that allows for rotation of the fangs backward when the mouth is closed; no post-fang teeth behind fangs (Family Viperidae) 29



Left to right: (1) Loreal absent, nasal in contact with preocular (*Bungarus wanghaotingi*); (2) loreal present, separating nasal and preocular (*Azemiops feae*); (3) head covered with small scales, sensory pit absent (*Daboia russelii*); (4) head covered with small scales, sensory pit present (*Trimeresurus erythrurus*)

2a. Tail flattened laterally, oar-like (Fig. 5) 13

2b. Tail rounded, tapering (Fig. 6) 3



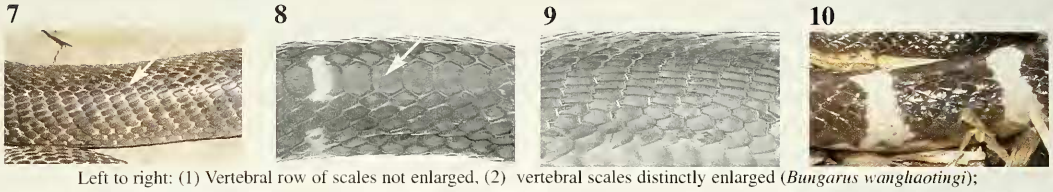
(5) Oar-like tail (*Laticauda laticaudata*), which is characteristic of all venomous sea snakes versus (6) a tapering or at least non-flattened tail (*Trimeresurus purpureomaculatus*), characteristic of all terrestrial snakes

3a. Vertebral series of scales not enlarged (Fig. 7); scales on sides of body obliquely arranged or not 4

3b. Vertebral series of scales enlarged (Fig. 8), distinctly larger than scales on sides of body; scales on sides of body not obliquely arranged 9

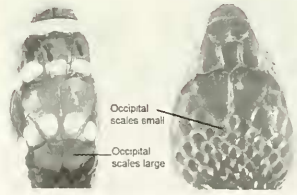
[1] In preparing this key and the checklist that follows, we have been guided by the latest revisionary studies, but we have also taken a conservative position because of the nature of the animals with which we are working. Thus, although we accept McDowell's argument that among the sea snakes *Enhydrina schistosa* should be referred to the genus *Disteira* and *Thalassophis viperina* to *Lapemis,* we have not done so here. Most of the medical and general literature dealing with sea snakes still refer to *Enhydrina schistosa* and *Thalassophina viperina.* Also, we have, rather arbitrarily, chosen to accord all recognizably distinct allopatric subspecies full species status rather than get embroiled in endless arguments of why raise one subspecies to full species status but retain another as a subspecies, though both can be readily, though differentially, diagnosed taxonomically. Arguments as to what constitutes a biological "species" versus "subspecies" are pointless and are usually based on an arbitrary assessment by a given worker on just how "important" a given character or character state is in inferring the "closeness" of biological affinities, i.e. the genealogical relationships among the parties.

4a. Scales on sides of body obliquely arranged (Fig. 9), pointing backward and downward, most distinct on sides of neck; scales in 15 to 23 longitudinal rows around midbody 5
4b. Scales on sides of body not obliquely arranged (Fig. 10), in straight longitudinal rows; scales in 13 to 15 longitudinal rows around midbody 7



Left to right: (1) Vertebral row of scales not enlarged, (2) vertebral scales distinctly enlarged (*Bungarus wanghaotingi*); (3) body scales, except for outer two or three horizontal rows, obliquely arranged (*Naja mandalayensis*); (4) body scales in parallel rows, not obliquely arranged

5a. Scales in 15 longitudinal rows at midbody; a pair of large occipital shields present (Fig. 11). . . . . *Ophiophagus hannah*
5b. Scales in 19–25 longitudinal rows at midbody; no enlarged occipital shields (Fig. 12). 6



Head scutellation in cobras: (11) Paired occipital shields present (*Ophiophagus hannah*); (12) No enlarged occipital shields (*Naja* sp.)

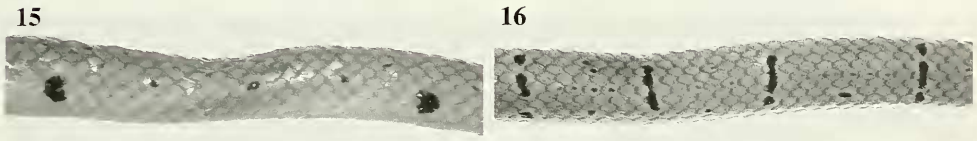
6a. Usually distinct dark markings on the hood; throat cream colored, often with a pair of well-defined lateral spots; when present, only a single dark band on the throat, otherwise venter either pale or gradually increasingly cloudy with dark pigment towards the rear, posteriorly venter often totally dark . . . . . *Naja kaouthia*
6b. No or only faintly distinct markings on the hood; throat extensively darkly mottled anterior to first dark throat band, mottling obscuring the throat spots characteristic of most species of *Naja*; at least two distinct dark bands on venter, one on the throat followed by a second on anterior third of venter; venter otherwise pale with some dark mottling *Naja mandalayensis*

7a. Anal scute divided (Fig. 13). 8
7b. Anal scute single (Fig. 14); preocular scale present; snout and venter free of dark pigment (no confirmed records for Myanmar). . . . . *Calliophis bivirgatus*

(13) Anal plate divided (*Sinomicrurus macclellandi*); (14) Anal plate undivided (single) (*Calliophis bivirgata*)

8a. Pattern on dorsum characterized by small black spots (Fig. 15), sometimes forming longitudinal stripes, with two black bands or rings on tail, one at base and one at the tip; one to three small maxillary teeth behind fangs ..... *Calliophis maculiceps*

8b. Pattern on dorsum characterized by small but distinct black vertical bars on sides (Fig. 16), sometimes forming crossbars, with two black rings on tail; no maxillary teeth behind fangs ..... *Sinomicrurus macclellandi*



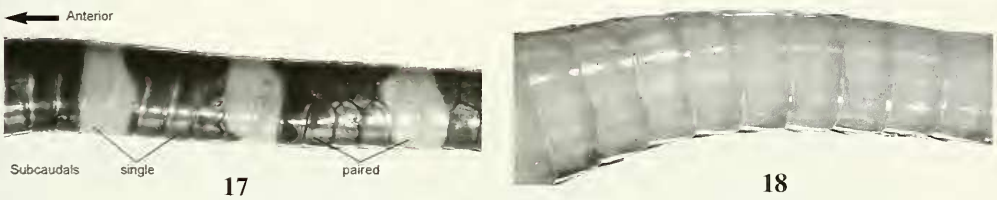
Dorsal color patterns: (15) Spotted pattern of *Calliophis maculiceps*; (16) Barred pattern of *Sinomicrurus macclellandi*

9a. Scales in 13 longitudinal rows at midbody; terminal caudal scales paired ..... *Bungarus flaviceps*

9b. Scales in 15 longitudinal rows at midbody; terminal caudal scales single or paired 10

10a. Subcaudal scales usually paired, occasionally some unpaired anteriorly (Fig. 17), but terminal scales always paired. ..... *Bungarus bungaroides*

10b. Subcaudal scales entire (Fig. 18), not paired 11



Subcaudal scutes: (17) Mixed paired and unpaired (*Bungarus bungaroides*); (18) All single (unpaired) (*Bungarus fasciatus*)

11a. Tail tapers to a point (Fig. 6); neural processes of vertebrae not enlarged vertically and do not produce a distinct ridge down the back; dorsal crossbars do not encircle body; belly white 12

11b. Tail ends bluntly, not pointed; neural processes of vertebrae enlarged vertically and produce a distinct ridge down the back; body marked with alternating black and yellow bands that completely encircle body ..... *Bungarus fasciatus*

12a. 27–48 narrow white crossbars on back, crossbars narrowest middorsally, expanding on sides ..... *Bungarus wanghaotingi*

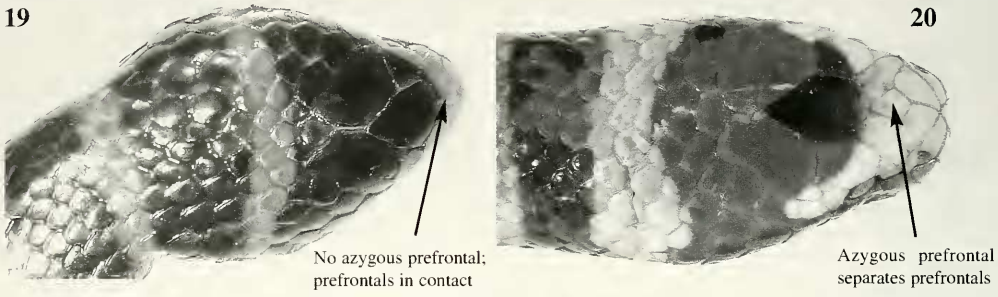
12b. 11–14 broad white, black-spotted crossbars on back, crossbars as broad as or broader than the darker interspaces ..... *Bungarus magnimaculatus*

13a. Ventral scales large, one-third to one-half the width of the body; maxillary bone extends forwards beyond palatines; nostrils lateral, nasal scales separated by internasals. 14

13b. Ventral scales small, less than one-fourth width of body, often smaller than or at least not larger than adjacent body scales; maxillary bone usually does not extend forwards beyond palatine (exceptions, *Kerilia jerdoni*, *Hydrophis gracilis* and *H. cantoris*); nostrils variable, internasal scales absent, nasal scales in contact with one another 15

14a. Scales in 19 longitudinal rows at midbody; no azygous (median) prefrontal scale (Fig. 19) ..... *Laticauda laticaudata*

14b. Scales in 21–25 longitudinal rows at midbody; an azygous (median) prefrontal scale usually present (Fig. 20) ..... *Laticauda colubrina*



Azygous prefrontal shield: (19) Absent in *Laticauda laticaudata*; (20) Present in *Laticauda colubrina*

15a. Ventral scales small but distinct, undivided by a median groove or, if divided posteriorly, the two halves either apposed or alternating with one another, then head very small and body long and very slender anteriorly 16

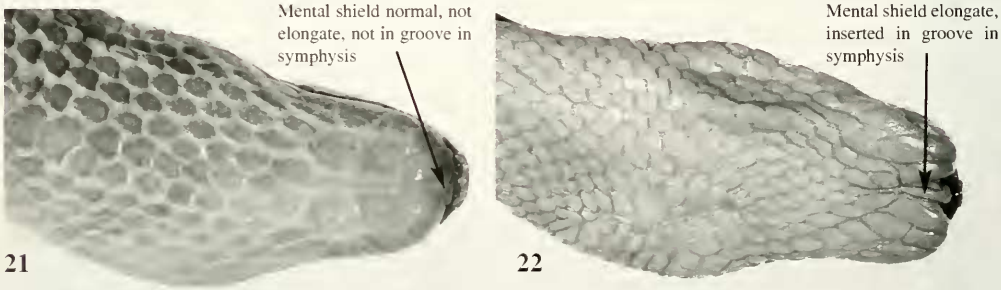
15b. Ventral scales, if distinct, then either divided by a median groove or smaller than adjacent body scales 28

16a. Scale rows in 23 or fewer rows around midbody; maxillary bone extends forwards beyond palatine; little or no space (diastema) separates fangs from smaller maxillary teeth ..... *Kerilia jerdoui*

16b. Scale rows in 25 or more rows around midbody (but often fewer around neck); maxillary bone does not extend forwards beyond palatine (except in *H. gracilis* and *H. cautoris*); a distinct space (diastema) separates fangs from smaller maxillary teeth 17

17a. Mental scale normal (Fig. 21) 18

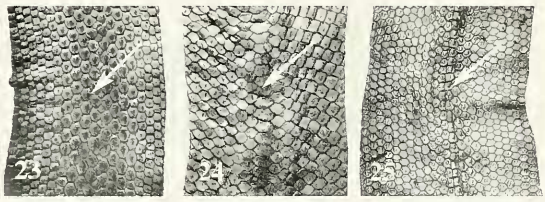
17b. Mental scale elongate, partially hidden in groove in the symphysis (Fig. 22); ventrals uniform in size; 3–5 small maxillary teeth behind fangs ..... *Enhydrina schistosa*



Mental shield: (21) Mental normal, neither elongate nor partially hidden in groove in the symphysis (*Hydrophis*); (22) Mental elongate, hidden in groove of symphysis when mouth is closed (*Enhydrina schistosa*)

18a. Ventral scales broad anteriorly, reduced posteriorly and not distinct from adjacent scales (Fig. 23); 5 maxillary teeth behind fangs ..... *Thalassophina viperina*

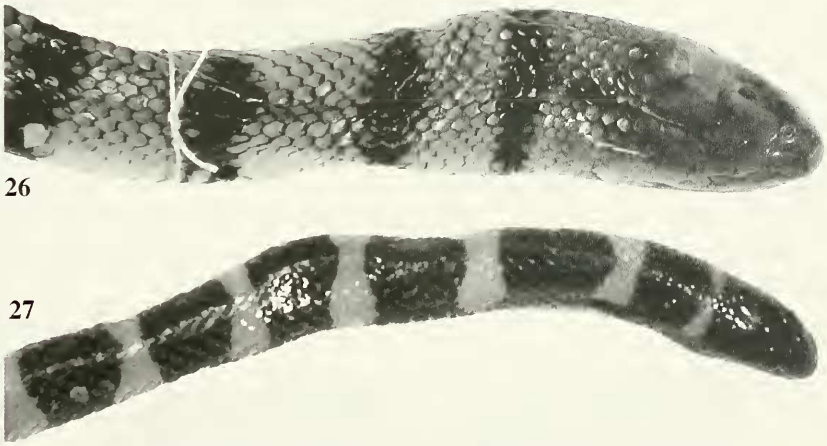
18b. Ventral scales slightly distinct from adjacent scales and of uniform shape throughout irrespective of their size, (Fig. 24); 1–18 maxillary teeth behind fangs 19



Ventral scutes: (23) Undivided and indistinguishable from adjacent scales (*Lapemis hardwickii*); (24) Usually distinguishable from adjacent scales (*Hydrophis cyanocinctus*); (25) Divided by a longitudinal groove (*Hydrophis gracilis*) (From Smith, 1926, pl. 1, figs. 3, 4, and 1.)

19a. Head very small, body elongate, anterior fifth slender, about same diameter as head (Fig. 27); ventrals small, posterior series usually divided by a longitudinal groove (Fig. 25), the two halves either apposed or alternating with one another; maxillary bone extends as far forward as anterior tip of palatine or beyond; 5–6 small maxillary teeth behind anterior fangs 20

19b. Head not distinctly reduced, body not particularly slender anteriorly (Fig. 26); ventrals small, usually distinct throughout and entire, only rarely are a few divided by a longitudinal groove; maxillary bone does not extend forward beyond palatine; 1–18 small maxillary teeth behind anterior fangs 23



Head and body dimensions: (26) head and anterior portion of body not distinctly narrowed (*Hydrophis spiralis*); (27) head and anterior fourth of body slender (*Hydrophis atriceps*)

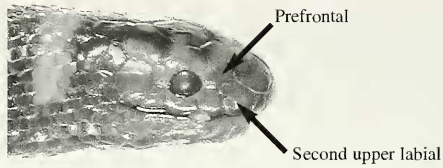
20a. Ventral scales entire throughout; head black 21

20b. Ventral scales anteriorly entire, posteriorly at least some divided by a longitudinal groove (Fig. 25); head color variable 22

21a. Scales in 28–33 rows on neck, 49–58 around midbody; ventrals 414–514 ..... *Hydrophis* (*Hydrophis*) *fasciatus*

21b. Scales in 25–30 rows on neck, 39–49 around midbody; ventrals 323–452 ..... *Hydrophis* (*Hydrophis*) *atriceps*

22a. Prefrontal scale usually in contact with second upper labial (Fig. 28); ventrals 220–350; 17–23 scale rows around neck ..... *Hydrophis* (*Hydrophis*) *gracilis*
22b. Prefrontal scale usually in contact with third upper labial; ventrals 404–468; 23–25 scale rows around neck, rarely 21 ..... *Hydrophis* (*Hydrophis*) *cantoris*



28

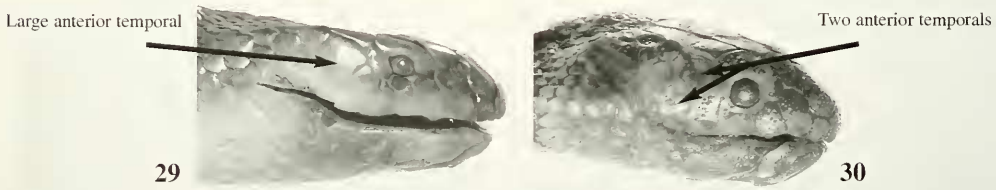
(28) Lateral view of head of *Hydrophis gracilis* showing contact of prefrontal with second upper labial; third and fourth upper labials border eye

23a. Scales at midbody rounded or bluntly pointed posteriorly, feebly to distinctly imbricate; 1–8 maxillary teeth behind anterior fangs 24
23b. Scales at midbody feebly imbricate or juxtaposed, quadrangular to hexagonal in shape; 8–18 maxillary teeth behind anterior fangs 26

24a. No enlarged anterior temporal scute, temporals small, scarcely distinguishable from surrounding scales; 1–2 maxillary teeth behind anterior fangs..... *Disteira nigrocincta*
24b. Normally one large anterior temporal scute (Fig. 29), clearly distinguishable from ordinarily scales, occasionally extending downward to border of lip 25

25a. 19–23 scale rows on neck; ventrals 300–338..... *Hydrophis* (*Hydrophis*) *obscurus*
25b. 25–31 scale rows on neck; ventrals 295–362 ..... *Hydrophis* (*Leioselasma*) *spiralis*

26a. Normally two or three anterior temporals (Fig. 30); ventrals less than 350; head olive or gray in adult; 40–60 dark crossbands or rhomboidal spots, wider than light interspaces, becoming obscure with age; below yellowish or whitish 27
26b. Normally one anterior temporal (Fig. 29); ventrals 374–452; head dark gray or olive, or, if blackish dorsally, with yellow mottling on snout and sides; dorsum with 45–65 dark bands, becoming obscure with age; below pale; dentary teeth 19–22
..... *Hydrophis* (*Aturia*) *stricticollis*



29 30

(29) Single large anterior temporal (*Hydrophis spiralis*); (30) Two anterior temporals (*Hydrophis caerulescens*)

27a. Pale gray or olive above to almost white, with broad dark bars or rhomboidal spots separated by narrow interspaces; yellowish or whitish below; head olive; 8–13 maxillary teeth behind fangs..... *Hydrophis* (*Aturia*) *ornatus*
27b. Bluish-gray above, yellowish or whitish below, with 40–60 broad bands about twice as broad as interspaces; markings indistinct on older individuals, which are almost uniform gray; head

dark gray to black, occasionally with light curved marking in young; 13–18 maxillary teeth behind fangs. . . . . *Hydrophis (Atmria) caerulescens*

28a. Olive to gray above, whitish below, 35–55 narrow dark bands, occasionally uniform dark gray; midventral rows of body scales larger than adjacent lateral and dorsolateral scales; ventral scutes, if discernable, not divided by a longitudinal groove; 3–6 small maxillary teeth behind fangs; no discernable series of midventral scutes . . . . . *Lapemis hardwickii*

28b. Bicolored, ordinarily black above, yellow below, with some variation in which yellow extends further up on the sides and the black is restricted to a wide middorsal stripe; sometimes black bars on belly; tail mottled yellow and black; ventral scutes, when distinct, divided by a longitudinal groove; 8–10 maxillary teeth . . . . . *Pelamis platurus*

29a. Loreal pit present (Fig. 4); head distinctly triangular in shape 31

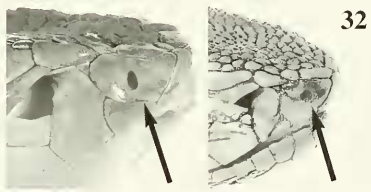
29b. Loreal pit absent (Figs. 2–3); head distinct from neck but variable in shape 30

30a. Loreal scale present but small (Fig. 2); head scutes large, symmetrical; dorsal scales in 17 longitudinal rows at midbody . . . . . *Azemiops feae*

30b. Loreal scale absent (Fig. 3); both top and sides of head covered by small, imbricate, distinctly keeled scales, except for the small, strongly crescentric supernasal, the large undivided nasal, and 10–12 upper labials . . . . . *Daboia russelii*

31a. First upper labial completely separated from nasal by a distinct suture (Fig. 31) 32

31b. First upper labial partially or completely fused to nasal (Fig. 32) 39



Nasal and first upper labial scales in *Trimeresurus* and *Ovophis*: (31) Nasal completely separated from first upper labial by suture (*Ovophis monticola*); (32) Nasal partially or completely fused to first upper labial (*Trimeresurus purpureomaculatus*)

32a. Body scales in 17–21 (rarely 23) longitudinal rows at midbody 35

32b. Body scales in 23–27 (rarely 21) longitudinal rows at midbody 33

33a. Ventrals more than 190 34

33b. Ventrals fewer than 190 (137–176 for Myanmar and adjacent areas of India, Thailand, and China, 127–144 further east); subocular scales usually fragmented into smaller scales . . . . . *Ovophis monticola*

34a. 8–10 scales in a line between supraoculars; ventrals 201–212; subcaudals 66–78; outermost one or two rows of body scales (those bordering ventrals) smooth, all other rows strongly keeled . . . . . *Protobothrops kaulbacki*

34b. 14–16 scales in a line between supraoculars; ventrals 200–218; subcaudals 76–91; outermost rows of body scales (those bordering ventrals) keeled . . . . . *Protobothrops mucrosquamatus*

35a. Body scales in 17 longitudinal rows at midbody; ventrals fewer than 150; bicolored ventrolateral stripe present in both males and females . . . . . *Trimeresurus medoensis*

35b. Body scales in 19–21 longitudinal rows at midbody; ventrals more than than 150; ventrolateral stripe variable 36

36a. Dominant background body color green; dorsum of head green 37
36b. Dominant background body color variable, greenish or olive above with series of transverse, rhomboidal, or irregular reddish brown to black spots or blotches, to entirely black; dorsum of head black with symmetrically arranged yellow markings; belly yellow with black spotting . . . . . *Protobothrops jerdonii*

37a. Scales in 19 (rarely 21) longitudinal rows at midbody and 19 (–21) on neck; ventrals 155–165 (–170); subcaudals (58–) 61–68 (in Myanmar from Kachin and ?Chin States); ventrolateral stripe bicolored (orange or brown below, white above) in males, white or absent in females . . . . . *Trimeresurus yunnanensis*
37b. Scales in 21 longitudinal rows at midbody (21–23 on neck); ventrolateral stripe bicolored (orange or brown below, white above) in males, bicolored or white only in females 38

38a. Ventrals: males 161–172, females 157–169; subcaudals: males 71–79, females 58–74; hemipenes long, slender, extending to level of 20^{th} – 25^{th} subcaudal scale, forked at level of fifth subcaudal scale, without spines (in Myanmar, known from vicinity of Mergui); ventrolateral stripe bicolored (orange or brown below, white above) in males, white in females . . . . . *Trimeresurus popeiorum*
38b. Ventrals (for Chinese specimens only [after Zhao et al. 1998 and David et al. 2001]): 154–172; subcaudals: 43–75; hemipenes short, stout, extending to 10^{th} subcaudal plate, forked at level of fifth subcaudal scute, spinose (species not presently known from Myanmar but possibly in north and east); ventrolateral stripe bicolored (orange or brown below, white above) in males, bicolored or white in females. . . . . *Trimeresurus stejnegeri*

39a. Scales in 21 (rarely 19) longitudinal rows at midbody; temporal scales smooth or weakly keeled; dorsum of head uniform green; tail usually not spotted with brown (in juveniles, tip of tail brown) . . . . . *Trimeresurus albolabris*
39b. Scales 23 or more longitudinal rows at midbody; temporal scales keeled; tail usually spotted with brown 40

40a. Head uniform green; body green above, pale green to yellowish below; ventrals: males, 153–174, females, 151–180; subcaudals: males, 62–79, females, 49–61 . . . . . *Trimeresurus erythrurus*
40b. Head and body brown to purplish-brown above, whitish to brown below; ventrals: males, 160–179, females 168–183; subcaudals: males 74–76, females 56–63 . . . . . *Trimeresurus purpureomaculatus*

Checklist of the Dangerously Venomous Snakes of Myanmar

Family Elapidae

Subfamily Elapinae

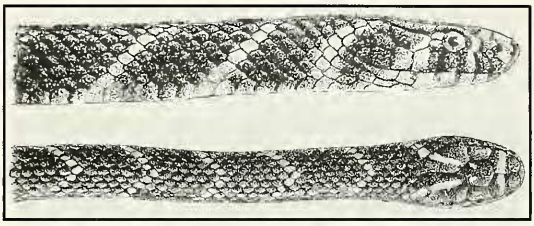
Genus *Bungarus* Daudin, 1803

Bungarus Daudin, 1803. (Type species: *Bungarus annularis* Daudin, 1803 [=*Pseudoboa fasciata* Schneider, 1801]).

Bungarus bungaroides (Cantor, 1839)

Elaps bungaroides Cantor, 1839:33. (Type locality: Cherra Punghi, Khasi Hills, Meghalaya State, India; Holotype: BMNH 1946.1.17.91).

Bungarus bungaroides, Smith, 1943:410.— Toriba, 1993:118.— David and Ineich, 1999:66.



Bungarus bungaroides (from Boulenger 1893, pl. 18, fig. 5).

Diagnostic characters.— Dorsal scales in 15 longitudinal rows at midbody; subcaudal scutes ordinarily divided anteriorly, but occasionally some scutes may be single, but always divided near the tip; ventrals 220–237; subcaudals 44–51; dorsum black with a series of very narrow white to pale yellowish lines or crossbars; on the belly, the light crossbars widen to form distinct transverse bars. Total length[1] 1400 mm; tail length 160 mm (largest male).

Distribution.— Myanmar (Map p. 458): Kachin State. Elsewhere: India (Sikkim; Assam [Khasi Hills]); Cachar.

Habitat.— Historically recorded in northern Myanmar (Smith 1940), this species has been documented at elevations of 2040 m (Boulenger 1896:371). In Myanmar, to date, this species has been found only in the subtropical forests of extreme northern Myanmar.

Bungarus fasciatus (Schneider, 1801)

Pseudoboa fasciatus Schneider, 1801:283 (Type locality: Mansoor, Cottah, Bengal, India; Holotype: based on Russell, 1796:3 and pl. iii).

Bungarus fasciatus, Smith, 1943:411.— Toriba, 1993:119.— David and Ineich, 1999:68.

Bungarus fasciatus. Photo by Francis Lim.

Diagnostic characters.— Dorsal scales in 15 longitudinal rows at midbody; subcaudal scutes undivided throughout; middorsal row of scales (vertebrals) strongly enlarged, as broad as or broader than long; tail end blunt; distinct vertebral ridge down the back formed by the neural processes of the vertebrae; ventrals 200–234; subcaudals 23–39; pattern of black and yellow bands, all of which encircle body. Total length recorded to 2125 mm, said to be rare over 1800 mm. (Smith, 1943:412.)

Distribution.— Myanmar: widely distributed (Ayeyarwady Division, Kachin State,

[1] Body and tail lengths are mostly taken from Smith (1943).

Magway Division, Mandalay Division, Rakhine State, Yangon Division). ELSEWHERE: central and northeastern India throughout all of southeastern Asia including southern China, Thailand, Cambodia, Laos, Vietnam, and Malaysia, to western Indonesia (Java, Sumatra, Kalimantan).

HABITAT.— In Myanmar, this species has been found primarily in low-lying regions with elevations from close to sea level to around 300 m. Historical records, however, indicate elevations up to 2300 m (Schleich and Kästle 2002). Most of the individuals encountered have been found in degraded habitat in the vicinity of villages and agriculture (including paddy). Several have been found along or near streams. Elsewhere, it is recorded from a diverse array of habitat types (see Pawar and Birand 2001; Das 2002; Schleich and Kästle 2002). Active at night.

Bungarus flaviceps Reinhardt, 1843

Bungarus flaviceps Reinhardt, 1843:267, pl. iii, fig. 4 (Type locality: Java; Holotype: ZMC R65301).— Smith, 1943:410.— Toriba, 1993:119.— David and Ineich, 1999:68.

DIAGNOSTIC CHARACTERS.— Dorsal scales in 13 longitudinal rows at midbody; expanded neural crest of vertebrae forms distinct ridge down back and tail; subcaudal scutes undivided, anteriorly those near the tip divided; ventrals: ♂ 220– 236, ♀ 193–217; subcaudals: ♂ 47–53, ♀ 42– 54. Black above; orange-yellow dorsal stripe often present; interstitial skin orange-yellow giving appearance of longitudinal stripes; head orange-yellow; tail and posterior part of body orange-yellow; belly orange or yellow, sometimes edged with brown. (After Smith, 1943:411.) Total length 1850 mm; tail length 220 mm.

Bungarus flaviceps. Photo by Francis Lim.

DISTRIBUTION.— MYANMAR (Map p. 458): Tanintharyi Division. ELSEWHERE: Thailand, Malayasia, Cambodia, Vietnam, western Indonesia.

HABITAT.— In Borneo and Thailand this species is found primarily in forested areas from sea level to around 900 m in elevation. In Sumatra, it is reported to inhabit low lying hills with a preference for tropical wet forests (David and Vogel 1996). It is generally found under leaf litter and beneath logs. Active at night (Cox et al 1998; Stuebing and Inger 1999).

REMARKS.— In Myanmar, this widely distributed Malaysian species has been recorded only from the extreme south, in the vicinity of Myeik (formerly Mergui) and Pyin Mountain.

Bungarus magnimaculatus Wall and Evans, 1901

Bungarus caeruleus magnimaculatus Wall and Evans, 1901:611 (Type locality: Meiktila, Upper Burma; Holotype: BMNH 1908.6.23.90).

Bungarus magnimaculatus, Smith, 1943:417.— Toriba, 1993:120.— David and Ineich, 1999:69.

DIAGNOSTIC CHARACTERS.— Dorsal scales in 15 longitudinal rows at midbody; subcaudal scutes undivided throughout; middorsal row of scales (vertebrals) strongly enlarged, as broad as or broader than long; tail tapering, terminating in a point; ventrals 214–235; subcaudals 40–48. Dorsum with 11–14 broad, white crossbars, as wide as the black interspaces, the centers of each of the scales spotted with black; belly uniformly white. Total length 1300 mm; tail length 150 mm.

Distribution.— Myanmar (Map p. 458): Magway, Mandalay,and Sagaing Divisions.

Habitat.— An endemic to Myanmar, recent herpetological surveys have found this species primarily in indaing diptocarp forests (moist deciduous). The type locality of Meiktila, Upper Burma (referable to Mandalay Division), lies in seasonal dry forest; thus, this species is likely to occur throughout the central dry zone. Individuals have been located in disturbed habitats near villages and in agriculture areas. Active at night.

Bungarus magnimaculatus. Photo by Joseph B. Slowinski.

Bungarus wanghaotingi Pope, 1928

Bungarus multicinctus wanghaotingi Pope, 1928:3 (Type locality: Yuankiang, Yunnan, China; Holotype: AMNH 35230).— Toriba, 1993:121.— David and Ineich, 1999:69.

Bungarus multicinctus (part) Smith, 1943:416.

Diagnostic characters.— Dorsal scales in 15 longitudinal rows at midbody; subcaudal scutes undivided throughout; middorsal row of scales (vertebrals) strongly enlarged, as broad as or broader than long; tail tapering, terminating in a point; ventrals 209–228, subcaudals 44–54 (*fide* Pope 1935:339, Smith 1943: 416). Belly uniformly white; dorsum with 20–31 light crossbands, crossbars narrower than black crossbars; 7–11 white crossbars on tail. Total length 1100 mm; tail length 145 mm.

Bungarus wanghaotingi. Photo by Hla Tun.

Distribution.— Myanmar (Map p. 458): Kachin State, Rakhine State, Sagaing Division, and Yangon area (doubtful). Elsewhere: China (Yunnan).

Habitat.— This species has been found in a diverse set of habitats, from bamboo stands in coastal rainforest to streams in indaing forest (moist deciduous), to subtropical forests in Kachin State. Individuals have been encountered primarily in degraded habitats near villages and along roads. Wall (1926:564) noted that it has been found at low to mid-range elevations, at least up to about 900 m. A mating pair was found at night on 10 September in northern Kachin State. Active at dusk and at night.

Remarks.— Closely related to but geographically distant from typical *B. multicinctus*. From *B. multicinctus*, it can be distinguished by the lower number of light cross bands on the body and tail (31–40 on the body and 9–17 on the tail in *B. multicinctus*, 20–31 and 7–11 respectively in *B. wanghaotingi*). The "*multicinctus-wanghaotingi*" species group requires study; it is likely polytypic and several closely related though distinct species likely are hidden presently under the names *multicinctus* and *wanghaotingi*.

Genus *Calliophis* Gray, 1834

Calliophis Gray, 1834, pl. 86, fig. 1 (Type species: *Calliophis gracilis* Gray, 1834).

Maticora Gray, 1834, pl. 86, fig. 2 (Type species: *Maticora lineata* Gray, 1834 [=*Aspis intestinalis* Laurenti, 1768]).— Slowinski, Boundy, and Lawson, 2001:239.

Remarks.— Bourret (1935:414) lists "Burmanie" in his distribution statement for *Maticora bivirgata*, but Smith (1943:419) observed, "I do not know of any authentic records of the occurrence of this Malayan genus, now known as *Maticora*, within the area covered by this work." Toriba (1993:151–152) also includes Myanmar in his range statement for *M. bivirgata* (and, as an aside, he places *C. maculiceps* in *Maticora*) but he, too, does not cite new evidence to justify its inclusion. Under the circumstances, we have chosen to remove *M. bivirgata* from the faunal list for Myanmar inasmuch as to date none have shown up in the survey collections that have been conducted during the past four years.

Regarding the status of the nominal genus *Maticora*, recent work has shown that the genus and its included species, *M. bivirgatus, M. intestinalis, M. maculiceps* (*fide* Toriba 1993), and *M. nigrescens*, are properly placed in the genus *Calliophis* (Slowinski, Boundy, and Lawson 2001).

Calliophis maculiceps Günther, 1858

Elaps maculiceps Günther, 1858:232 (Type locality: East Indies; Holotype: BMNH 58.4.20.6).
Callophis maculiceps, Smith, 1943:420.
Maticora maculiceps, Toriba, 1993:153.— David and Ineich, 1999:128.
Calliophis maculiceps, Slowinski, Boundy, and Lawson, 2001:235–241.

Diagnostic characters.— Body scales in 13 parallel longitudinal rows, not obliquely disposed; middorsal (vertebral) scales not enlarged); preocular in contact with nasal; ventrals: ♂ 174–186, ♀ 189–203; subcaudals: ♂ 25–31, ♀ 21–25; body above brown to reddish brown, with black spots, the latter arranged longitudinally along each side of the back; head and nape black with some yellow markings including a yellow spot on each side of the occiput; upper labials yellow; tail, below, pale blue or gray. Total length 1300 mm; tail length 150 mm.

Calliophis maculiceps. Photo by Hla Tun.

Distribution.— Myanmar (Map p. 459): as far north as 20°N. Elsewhere: Thailand, Cambodia, Laos, Malaysia.

Habitat.— Cox et al. (1998) report this species from low elevation forests. The lone individual encountered during our recent surveys was found at night near a stream in a rubber and beetlenut plantation at an elevation of 43 m. The surrounding habitat is coastal rainforest and semi-evergreen forest. In Thailand, it is usually found under vegetation, rocks or logs (Cox 1991).

Genus *Naja* Laurenti, 1768

Naja Laurenti, 1768 (Type species: *Naja lutescens* Laurenti, 1768 [=*Coluber naja* Linnaeus, 1758]).

Naja kaouthia Lesson, 1831

Naja kaouthia Lesson, 1831:122 (Type locality: Bengal; Holotype: unknown).— Toriba, 1993:187.— David and Ineich, 1999:159.
Naja naja kaouthia, Smith, 1943:428, 431.

Diagnostic characters.— Body scales smooth, arranged in 19–21 (usually 21) longitudinal rows at mid-body; throat pale, scarcely any dark mottling, often followed by a single dark band, ventrolateral throat spots distinct; remainder of venter either pale or increasingly cloudy with darker pigmentation towards the rear; in adults, hood markings usually distinct, usually a pale, oval or

circular marking, with a dark center (see fig., left image) and occasionally a narrow dark outer border; occasionally 1 or 2 dark spots are present in the pale oval; fangs not modified for spitting, venom discharge orifice large; ventrals 164–196; subcaudals 43–58. Total length 1500 mm; tail length 230 mm (according to Smith [1943:429] larger specimens have been recorded, but they are rare).

Naja kaouthia. Photo by Hla Tun.

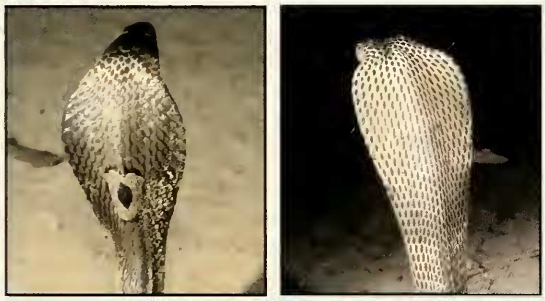
Distribution.— Myanmar (Map p. 459): widely distributed throughout the country in wetter habitats (Ayeyarwady Division, Chin State, Kachin State, Magway Division [part], Rakhine State, Sagaing Division [part], Yangon Division); in the drier central region, spanning Mandalay, Magway [part], and Sagaing [part] Divisions, it is replaced by *Naja mandalayensis* (*q.v.*). Elsewhere: Nepal, Bangladesh, northeastern India (Assam), Thailand (also in the wetter areas), northern Malaysia, Cambodia, southern Laos and southern Vietnam, southwestern China (Sichuan, Yunnan).

Habitat.— Widely distributed in Myanmar except in the central dry zone (dry and moist deciduous forests) where its close relative, *N. mandalayensis,* occurs. *Naja kaouthia* is often encountered in villages, in agricultural areas, and grasslands, but it is also met with in primary coastal rainforest. It has also been encountered swimming in lakes and rivers, as well as beneath rocks and in the burrows of other animals. Additionally, Cox (1991) observes that it can climb trees. In Myanmar, it has been recorded from sea level to 820 m. Although most active at dusk and night, it may be encountered during the daylight hours as well.

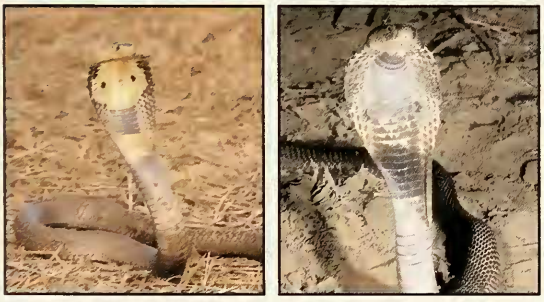
Naja mandalayensis Slowinski and Wüster, 2000

Naja naja kaouthia, Smith, 1943:431 (part).

Naja mandalayensis Slowinski and Wüster, 2000:257–270, figs. 1–2 (Type locality: near Monywa [22°13′N, 95°20′E], Sagaing Division, Myanmar; Holotype: CAS 207097).



Hood markings in *Naja kaouthia* (left) and *Naja mandalayensis* (right). Photos by Dong Lin.



Underside of throat and anterior third of body color patterns for *Naja kaouthia* (left) and *Naja mandalayensis* (right). Photos by Dong Lin.

Diagnostic characters.— Underside of chin and throat dark, set off from first dark band by 2 to 4 ventrals that are either pale or at least less densely mottled, followed by 2 or 3 broad dark bands, the remainder of the venter is pale with occasional dark mottling; hood without markings (see fig., right image) or, if present, scarcely discernible; fangs modified for spitting, venom discharge orifice small; ventrals: 173–185 (♂ 173–185, ♀ 182–185); subcaudals: 50–58 (♂ 56–58, ♀ 50–56). Total length 828 mm; tail length 152 mm (dimensions of holotype, a rather small specimen, as recorded by Slowinski and Wüster; larger individuals undoubtedly occur).

Distribution.— Myanmar (Map p. 459): Central dry zone, including parts of Sagaing, Mandalay, and Magway Divisions.

Habitat.— This species appears to be restricted to the central dry zone. Most individuals have been found in the vicinity of villages and agricultural lands.

Genus *Ophiophagus* Günther, 1864

Ophiophagus Günther, 1864 (Type species: *Hamadryas elaps* Günther, 1858 [= *Naja hannah* Cantor, 1836]).

Ophiophagus hannah (Cantor, 1836)

Hamadryas hannah Cantor, 1836:187 (Type locality: Sandarbans, near Calcutta, India; Holotype: Unknown).
Naja hannah, Smith, 1943:436, fig. 140.
Ophiophagus hannah, Toriba, 1993:195.— David and Ineich, 1999:171.

Diagnostic characters.— Body scales smooth, obliquely arranged, in 17–19 rows on the neck, 15 at midbody; middorsal (vertebral) row and outer 2 lateral rows larger than others; ventrals 240–254; subcaudals 84–104, anterior scutes undivided; juveniles are usually dark brown or black with white or yellow cross bars, anteriorly the bars are chevron-shaped but straighten out posteriorly; with age, the light pattern disappears, and older adults are uniformly brown although some indication of the light cross bars persists (in Myanmar, the banded pattern persists in adults); tail dark olive to black. Total length recorded to 5500 mm, but individuals rarely exceed 4250 mm; tail length approximately 20% of total length.

Distribution.— Myanmar (Map p. 459): widely distributed (encountered by the Survey team on occasion at localities in both Ayeyarwady and Mandalay Divisions). Elsewhere: widely distributed throughout Southeast Asia and east to the Philippines and western Indonesia.

Habitat.— In Myanmar, this species has been found in a variety of habitats, in dense forests, mangrove swamps, open country, and disturbed areas in the Ayeyarwady Delta, to the dry forests of the central dry zone to coastal rainforest in Tanintharyi. In Assam, Pawar and Birand (2001) confirm its presence in primary forest; in Thailand, Cox (1991) states that it is found in both forests

Ophiophagus hannah (adult). Photo by Hla Tun.

Ophiophagus hannah (juvenile). Photo by John Tashjian.

and plantations habitats; and in Peninsular Malaysia and Singapore, Lim and Lee (1989) note that it occurs in foothill jungles, open grasslands, in rural areas, and along jungle streams. David and Vogel (1996) state that in Sumatra it ranges from sea level to 1800 m.

Genus *Sinomicrurus* Slowinski, Boundy, and Lawson, 2001

Sinomicrurus Slowinski, Boundy, and Lawson, 2001:239 (Type species: *Elaps macclellandii* Reinhardt, 1844).

Sinomicrurus macclellandii (Reinhardt, 1844)

Elaps macclellandii Reinhardt, 1844:532 (Type locality: Assam, India; Holotype: Unknown).
Calliophis macclellandi, Smith, 1943:423.
Hemibungarus macclellandi, David and Ineich, 1999:98.
Hemibungarus macclellandi macclellandi, Toriba, 1993:142.
Sinomicrurus macclellandi, Slowinski, Boundy, and Lawson, 2001:239.
Sinomicrurus macclellandi macclellandi, Hallermann et al., 2002:151.

Sinomicrurus macclellandii. Photo by Nikolai Orlov.

Diagnostic characters.— Vertebral series of scales not enlarged; body scales in 13 parallel longitudinal rows; 1 preocular; 2 postoculars; 7 upper labials; temporals 1 + 1, the anterior shield in contact with 2 upper labials; color pattern red or brownish above with a series of narrow black transverse bars (sometimes a narrow, black vertebral stripe with transverse black bars restricted to sides of body [Eastern Himalayas] or black transverse bars reduced to transverse vertebral spots [Assam, Upper Myanmar]) (*fide* Smith 1943:424); head black anteriorly reaching back to the level of the eyes, followed by a broad white band, which is bordered posteriorly by a black nuchal band; ventrals: ♂ 182–212, ♀ 208–244; subcaudals, mostly paired, occasionally a few single: ♂ 28–36, ♀ 25–33. Total length: ♂ 635 mm, ♀ 780 mm; tail length: ♂ 70 mm, ♀ 60 mm.

Distribution.— Myanmar (Map p. 459): Kachin State south to (?) Yangon Division (based on questionable record). Elsewhere: India (Sikkim, Assam), Thailand, southern China, Vietnam.

Habitat.— The only specimen of this species from recent surveys was found in the subtropical forests (Northern Triangle) of Kachin State at an elevation of 526 m during the day. Outside of Myanmar, this species has been recorded from elevations of 350 m to 2000 m (Schleich and Kästle 2002). According to Das (2002), it is generally nocturnal. Cox (1991) reports that in Thailand it is usually found under loose soil or vegetation in forests up to 1800 m.

Subfamily Hydrophiinae

Genus *Laticauda* Laurenti, 1768

Laticauda Laurenti, 1768:109 (Type species: *Laticauda scutata* Laurenti, 1768).

Laticauda colubrina (Schneider, 1799)

Hydrus colubrinus Schneider, 1799:238 (Type locality: None specified; Holotype: ZMB 9078).
Laticauda colubrina, Smith, 1926:6; 1943:443.— Toriba, 1993:146.— David and Ineich, 1999:123.

Diagnostic characters.— Ventrals large, one-third to more than half the width of the body;

nostrils lateral; nasals separated by internasals; 21–25 longitudinal rows of imbricate scales at midbody; an azygous prefrontal shield usually present; rostral undivided; ventrals 213–243; subcaudals: ♂ 37–47, ♀ 29–35 (ventral and subcaudal counts after Smith 1943:443). Upper lip yellow. Total length: ♂ 875 mm, ♀ 1420 mm; tail length: ♂ 130 mm, ♀ 145 mm.

Laticauda colubrina. Photo by Dong Lin.

Distribution.— Myanmar (Map p. 460): coastal waters, tidal rivers, and ashore especially along rocky coasts. According to Smith (1943:444), this species is not commonly met in "Indian and Indo-Chinese waters" though it is not uncommon at Singapore. Minton (1975:26, table 1) suggests that although rare in the Bay of Bengal, it may not be uncommon along the Myanmar coast and the west coast of the Malayasian peninsula. Elsewhere: coastal waters of Thailand, Malaysia, and western Indonesia as far east as Polynesia and north along the east Asian coast and Philippines Islands to southern Japan.

Habitat.— Individuals of this species were found on a small, uninhabited island approximately one mile off the Rakhine coast in the Bay of Bengal. They were seen at rest during the day at low tide in rock crevices. Surrounding waters were rich in large corals. In New Caledonia, Ineich and Laboute (2002) report that it is often found inshore under vegetation. It has been found at depths of more than 60 m, but it appears to prefer depths of less then 20 m (Ineich and Laboute 2002). Active day and night (Ineich and Laboute 2002).

Laticauda laticaudata (Linnaeus, 1758)

Coluber laticaudatus Linnaeus, 1758:222 (part) (Type locality: "in Indiis"; Holotype: NHRM 87–88).
Laticauda laticaudata, Smith, 1926:4; 1943:442.— Toriba, 1993:146.— David and Ineich, 1999:124.

Diagnostic characters.— Ventrals large, one-third to more than one half the width of the body; nostrils lateral; nasals separated by internasals; 19 longitudinal rows of imbricate scales at midbody; no azygous prefrontal shield; rostral undivided; ventrals 225–243; subcaudals: ♂ 38–47, ♀ 30–35 (ventral and subcaudal counts after Smith 1943:443). Upper lip dark brown. Total length: ♂ 910 mm, ♀ 1070 mm; tail length: ♂ 110 mm, ♀ 110 mm.

Laticauda laticaudata. Photo by John Tashjian.

Distribution.— Myanmar (Map p. 460): Rakhine State. Smith (1943:443) states that it is "rare in the Oriental region (Calcutta and Little Nicobar Harbour)." On the other hand, Minton (1975:26, table 1) suggests that although rare in the Bay of Bengal, it may not be uncommon along the Myanmar coast and the west coast of the Malaysian peninsula. Elsewhere: western Indonesia (Sumatra and Java) to Australia, Melanesia and Polynesia, and north along the east coast of Asia to southern Japan.

Habitat.— This species has been found near the

mouth of a small freshwater stream along the Rakhine coast. The coast in this area is awash with exposed coral reef and mangrove forest. In Taiwan, Mao and Chen (1980) reported that it is often found near fresh water. Active day and night (Ineich and Laboute 2002).

Genus *Disteira* Lacépède, 1804

Disteira Lacépède, 1804 (Type species: *Disteira doliata* Lacépède, 1804 [=*Hydrus major* Shaw, 1802]).

Remarks.— At this time, we have chosen not to follow McDowell (1972) and continue to recognize the nominal genus *Enhydrina*, which he referred to the genus *Disteira*, and its included species, *E. schistosa*. We do so with some hesitation because we believe that McDowell was likely closer to the truth in synonymizing *Enhydrina* with *Disteira* and that the current arrangement merely perpetuates an unfortunate case of paraphyly. Pending further studies, however, we have chosen the conservative approach and follow McCarthy (1993) who recognizes the genus *Enhydrina* (*q.v.*) with its included species, *E. schistosa* and *E. zweifeli*.

Disteira nigrocincta (Daudin, 1803)

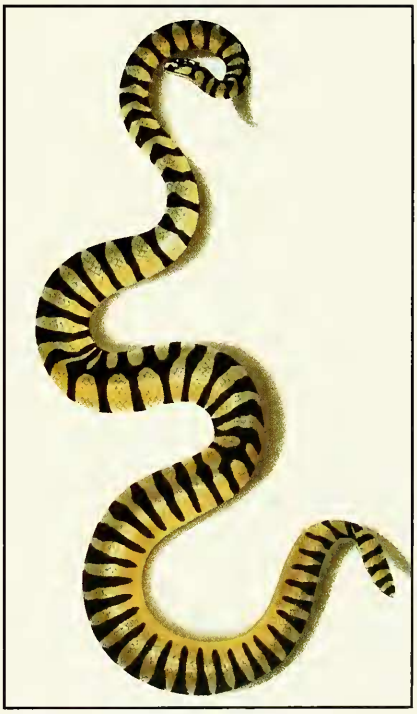
Hydrophis nigrocinctus Daudin, 1803:380 (Type locality: Sundarbans, Bengal; Holotype: BMNH 1946.1.10.13, but original description based on Russell, 1801, p. 7, pl. 6).— Smith, 1926:44, fig. 18; 1943:452.— David and Ineich, 1999:115.

Disteira nigrocincta, McDowell, 1972:239–244.— McCarthy, 1993:226.

Diagnostic characters.— Mental scute large, not concealed in mental groove; 1–3 maxillary teeth behind fangs; 7–9 palatine teeth, similar in size to ptergyoid teeth; head with yellow supraorbital stripe surrounding a blackish crown patch that extends forward to prefrontals; olive to brown above with 40 to 60 narrow dark annuli; yellowish below; 27–33 scale rows around neck, 39–45 around midbody, imbricate and keeled; ventrals 296–330, distinct throughout but not twice as large as adjacent scales; preanal scales enlarged. Total length 1080 mm, tail length 125 mm.

Distribution.— Myanmar: coastal waters and tidal streams bordering the Bay of Bengal. Elsewhere: known only from the Bay of Bengal and adjacent coasts.

Habitat.— Little is known about this species. Other members of this genus are diurnal and are found in deep, turbid, sandy bottom waters (O'Shea 1996).



Disteira nigrocincta. From Fayrer (1874, pl. 25).

Genus *Enhydrina* Gray, 1849

Enhydrina Gray, 1849:47 (Type species: *Enhydrina valakadyen* Gray, 1849 [= *Hydrus valakadyn* F. Boie, 1827 = *Hydrophis schistosus* Daudin, 1803]).

Remarks: See note above under the genus *Disteira*.

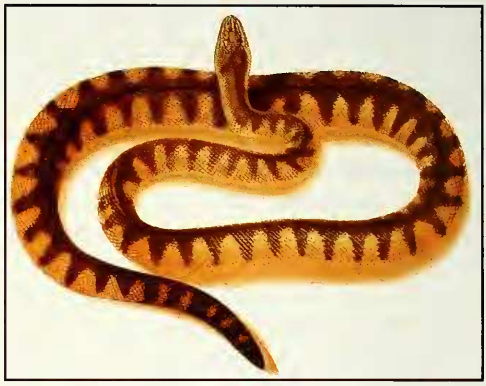
Enhydrina schistosa (Daudin, 1803)

Hydrophis schistosus Daudin, 1803:386 (Type locality: Tranquebar, South India; Holotype: BMNH 1946.1.10.7, but original description based on Russell, 1801, pl. 10).

Enhydrina schistosa, Smith, 1926:36, fig. 17; 1943:449, fig. 144.— McCarthy, 1993:227.— David and Ineich, 1999:92.

Disteira schistosa, McDowell, 1972:239–244.

Diagnostic characters.— Mental scute small, partly concealed within mental groove; 3–4 maxillary teeth behind fangs; 5–6 palatine teeth, palatine teeth larger than pterygoid teeth; no suborbital stripe; young dark gray above, whitish below, with dark gray or black annuli; pattern disappears in adults which are uniform gray in color; scales around body variable, in Bay of Bengal, scales around neck, males 43–52, females 48–55, scales around midbody, ♂ 53–60, ♀ 55–65, scales somewhat imbricate or juxtaposed, with short central keel; ventrals 262–322; preanal scales only slightly enlarged. Total length 1400 mm, tail length 180 mm (but rarely exceeding 1100 mm total length).



Enhydrina schistosa. From Fayrer (1874, pl. 18).

Enhydrina schistosa. Photo courtesy Indraneil Das.

Distribution.— Myanmar (Map p. 460): coastal waters (two specimens, one in the Myanmar Biodiversity Museum, the second at the California Academy of Sciences come from Ayeyarwady Division coastal waters). Elsewhere: coastal waters from the Persian Gulf east to Indonesia, New Guinea and northern Australia, and north from Malaysia to the Philippines.

Habitat.— According to Cogger (1975), in Australia this species is often found in rivers, but it is not clear if they are found in the brackish waters of the tidal basins or further away from the estuaries upstream in freshwater. Cox et al. (1998) likewise report that in Thailand *E. schistosa* is sometimes found in estuaries and rivers as well as coastal waters, but again it is not clear how far upstream they go. According to O'Shea (1996), this species prefers water of depths from less than 5 m to a maximum of around 30 m. The individuals encountered in our recent surveys were caught in nets at the mouth of a river. Active during day and night (O'Shea 1996).

Genus *Hydrophis* Latrielle, 1802

Hydrophis Latrielle, 1802:193 (Type species: *Hydrus fasciatus* Schneider, 1799).— Smith, 1926:40; 1943:451.— McCarthy, 1993:229.

Hydrophis atriceps Günther, 1864

Hydrophis atriceps Günther, 1864:371, fig. (Type locality: Siam; Syntypes: BMNH 1946.1.2.62, 63.9.29.5).— McCarthy, 1993:230.— David and Ineich, 1999:104.

Hydrophis fasciatus atriceps, Smith, 1926:97, fig. 27; 1943:465.

Diagnostic characters.— Head small, body long and slender anteriorly; scales on thickest part of body subquadrangular or hexagonal in shape, juxtaposed or slightly imbricate; 5–6 maxillary teeth behind fangs; 2 anterior temporals; body scales in 25–30 (usually 27–29) rows around the neck, 39–49 (usually 43–45) around midbody (increase in number of rows from neck to midbody 12–21, usually 14–18); ventral scales 323–452 (average 366 or less); anterior part of body including head and neck dark olive to black with pale oval yellowish spots on sides, sometimes connected as crossbars; posterior, grayish; below whitish; dark rhomboidal spots may extend down the sides of the body and form complete annuli in young. Total length ♂ 1100 mm, ♀ 990 mm; tail length ♂ 100 mm, ♀ 75 mm.

Distribution.— Myanmar (*fide* Toriba 1993), but according to Smith (1943:465), *H. atriceps* occurs from the Gulf of Siam eastward and is not known to the west. David and Ineich (1999:105) do not include Myanmar in its recorded range. All references to *H. atriceps* from the Bay of Bengal are most probably *H. fasciatus*, with which *H. atriceps* has long been associated.

Habitat.— Smith (1926) reports this species to be common at the mouths of rivers.

Remarks.— This species is so similar in appearance to *H. flaviceps* that the two have been regarded as conspecific, though treated as distinct subspecies (Smith 1926:97 and 1943:465). The differences between them are given in the diagnoses. *Hydrophis atriceps* should be removed from the Myanmar faunal list.

Hydrophis caerulescens (Shaw, 1802)

Hydrus caerulescens Shaw, 1802:561 (Type locality: Indian Ocean [Vizagapatam {=Visakhapatnam}]; Holotype: BMNH 1946.1.3.90).

Hydrophis caerulescens, Smith, 1926:90; 1943:463.— McCarthy, 1993:232.— David and Ineich, 1999:106.

Diagnostic characters.— Scales on thickest part of body quadrangular or hexagonal in shape, feebly imbricate or juxtaposed; 14–18 maxillary teeth behind front fangs; 2 anterior temporals; scales in 31–43 rows on the neck, 38–54 around midbody (increase from neck to midbody 6–14); ventrals 253–334, distinct throughout though not twice as large as adjacent body scales; bluish gray above, whitish below, with 40–60 broad bands, about twice as wide as interspaces, tapering ventrally (in older adults, bands become indistinct).

Distribution.— Myanmar: coastal waters, especially abundant in the Mergui Archipelago (Tanintharyi Division). Elsewhere: both west and east coasts of India (vicinity of Bombay and Karwar in the west and from Madras to the mouth of the Ganges on the east coast) east through Straits of Malacca to the Gulf of Siam to southeastern China and western Indonesia.

Habitat.— No data available.

Hydrophis cantoris Günther, 1864

Hydrophis cantoris Günther, 1864:374, fig. (Type locality: Penang, Malaysia; Holotype: BMNH 1946.1.18.30)— McCarthy, 1993:232.— David and Ineich, 1999:106.

Microcephalophis cantoris, Smith, 1926:124, fig. 35; 1943:475.

Diagnostic characters.— Head small, body long and slender anteriorly; scales on thickest part of body juxtaposed; 5–6 maxillary teeth behind fangs; 23–25 (rarely 21) scale rows around neck, 41–48 around thickest part of body (increase from neck to midbody 18–24); ventrals divided by a longitudinal fissure; prefrontal in contact with third upper labial; ventrals 404–468. Total length ♂ 1450 mm, ♀ 1880 mm; tail length ♂ 120 mm, ♀ 140 mm.

Distribution.— Myanmar: coastal waters. Elsewhere: coastal waters from Pakistan (Karachi) east, including India, Sri Lanka, Thailand and Malaysia.

Habitat.— No data available.

Hydrophis fasciatus (Schneider, 1799)

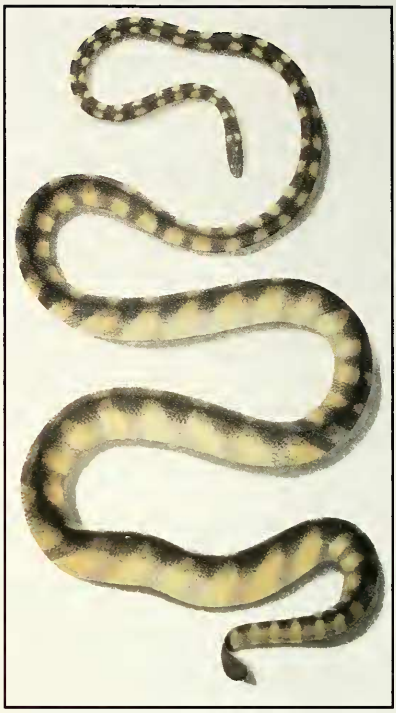
Hydrus fasciatus Schneider, 1799:240 (Type locality: East Indies; Syntypes: ZMB 2836–2837).
Hydrophis fasciatus, Smith 1926:94; 1943:464.— McCarthy, 1993:234.— David and Ineich, 1999:109.

Diagnostic characters.— Head small, body long and slender anteriorly; scales on thickest part of body subquadrangular or hexagonal in shape, juxtaposed or slightly imbricate; 5–6 maxillary teeth behind fangs; 2 anterior temporals; body scales in 28–33 rows around the neck, 47–58 around midbody (increase in number of rows from neck to midbody 20–27); ventral scales 414–514 (average 460); anterior part of body including head and neck dark olive to black with pale oval yellowish spots on sides, sometimes connected as crossbars; posterior, grayish; below whitish; dark rhomboidal spots may extend down the sides of the body and form complete annuli in young. Total length ♂ 1100 mm, ♀ 990 mm; tail length ♂ 100 mm, ♀ 75 mm.

Distribution.— Myanmar: coastal waters to the Straits of Malacca. Elsewhere: common along east coast of India (said to be rare along the west coast but it has been reported from as far west as Karachi).

Habitat.— Cox et al (1998) report this nocturnal species inhabits shallow coastal waters.

Remarks.— So similar in appearance to *H. atriceps* that the two have been regarded as conspecific, though treated as distinct subspecies (see Smith 1926:97 and 1943:465) (see also above, Remarks, under *H. atriceps*).



Hydrophis fasciatus. From Fayrer (1874, pl. 27).

Hydrophis gracilis (Shaw, 1802)

Hydrus gracilis Shaw, 1802:560 (Type locality: Unknown; Holotype: BMNH 1946.1.17.37).
Microcephalophis gracilis, Smith, 1926:121; 1943:472, fig. 150.
Hydrophis gracilis, McCarthy, 1993:234.— David and Ineich, 1999:110.

Diagnostic characters.— Head small, body long and slender anteriorly; scales on thickest part of body juxtaposed; 5-6 maxillary teeth behind fangs; 17–21 scale rows around neck, 30–36 around thickest part of body (increase from neck to midbody 18–24); ventrals divided by a longitudinal fissure; prefrontal in contact with third upper labial; ventrals 220–287. Total length ♂ 950 mm, ♀ 1025 mm; tail length ♂ 80 mm, ♀ 95 mm.

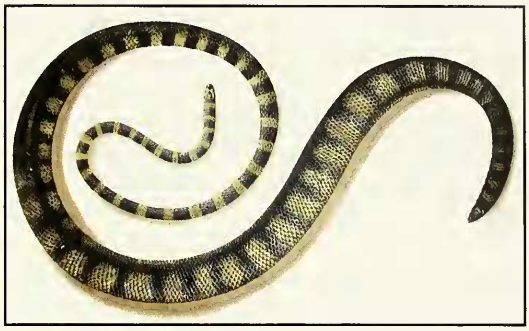
Distribution.— Myanmar: coastal waters. Elsewhere: coastal waters from the Persian Gulf east to India, Sri Lanka, Thailand, Malaysia, Vietnam, China, Taiwan, Indonesia (Sumatra and Java), Australia, Melanesia.

Habitat.— Reported to inhabit deep turbid offshore waters (O'Shea 1996).

Remarks.— Smith (1943:473) provides information on the geographic variation in scale counts for this species. The values included in the diagnosis above apply only to those populations inhabiting the coastal waters of Myanmar and along the east coast of India.

Hydrophis obscurus Daudin, 1803

Hydrophis obscura Daudin, 1803:375 (Type locality: Sandbarbans [*sic*], India; Holotype: BMNH 1946.1.9.27 [but original description based on Russell, 1801, pl. 8]).— Smith, 1926:66; 1943:457.— McCarthy, 1993:238.— David and Ineich, 1999:115.



Hydrophis obscurus. From Fayrer (1874, pl. 26).

Diagnostic characters.— Scales on thickest part of body with rounded or bluntly pointed tips, imbricate throughout; 5–7 maxillary teeth behind fangs; body elongate, ventrals distinct throughout, 300–338; 6–7 upper labials; 1 anterior temporal; 19–23 scale rows on neck, 29–37 on thickest part of body (increase from neck to midbody 8–14); young black with 35–55 bright yellow or whitish dorsal bars, posteriorly becoming complete bands that encircle body, head with curved yellow marking extending from snout to either side of parietal scales; adults markings become indistinct and older individuals almost uniform grayish above, yellowish below. Total length ♂ 1190 mm, ♀ 1200 mm; tail length ♂ 135 mm, ♀ 110 mm.

Distribution.— Myanmar: coastal waters especially of the Ayeyarwady Division and south (Tanintharyi Division). Elsewhere: east coast of India.

Habitat.— This species is reported to occur mainly in brackish waters (Smith 1926), and historical records indicate that it can be found at the mouths of rivers (*ibid.*).

Hydrophis ornatus (Gray, 1842)

Aturia ornata Gray, 1842:61 (Type locality: Indian Ocean; Holotype: BMNH 1946.1.23.72).
Hydrophis ornatus, Smith, 1926:6.— David and Ineich, 1999:116.
Hydrophis ornatus ornatus, Smith, 1943:460.— McCarthy, 1993:239.

Diagnostic characters.— Scales on thickest part of body more or less hexagonal in shape, feebly imbricate or juxtaposed; 10–13 maxillary teeth behind fangs; head large; body robust, not elongate, greatest diameter posteriorly about twice that of the neck; 1 preocular; 2 postoculars; 2 anterior temporals; 7–8 upper labials; scale rows on neck: ♂ 28–37, ♀ 31–45, on thickest part of body, ♂ 33–45, ♀ 39–55 (increase from neck to midbody 4–12); ventrals distinct throughout, in ♂ 209–260, in ♀ 236–312, anteriorly ventrals about twice as large as adjacent scales, narrowing posteriorly; above grayish or light olive to almost white with broad dark bars or rhomboidal spots sep-

Hydrophis ornatus. Photos by Dong Lin.

arated by narrow interspaces; below yellowish or whitish. Total length ♂ 950 mm, ♀ 860; tail length ♂ 115 mm, ♀ 80 mm.

Distribution.— Myanmar (Map p. 460): coastal waters. Elsewhere: widely distributed from the Persian Gulf east to New Guinea and Australia and north along the coast of China to the Ryukyu Archipelago.

Habitat.— Reported to inhabit clear waters with coral reefs, as well as turbid rivers and estuaries (O'Shea 1996; Ineich and Laboute 2002). Active at night and day (Ineich and Laboute 2002).

Remarks.— Smith (1943:461) recognized two subspecies, *H. o. ornatus* and *H. o. ocellatus*, the latter in the coastal waters of Australia. In 1993, McCarthy synonymized *H. o. ocellata* with *H. o. ornatus* but recognized *H. o. maresinensis*, described by Mittleman in 1947 to accommodate the populations found off the coast of China, Taiwan and the RyuKyu Islands.

Hydrophis spiralis (Shaw, 1802)

Hydrus spiralis Shaw, 1802:564 (Type locality: Indian Ocean; Holotype: BMNH 1946.1.6.94).
Hydrophis spiralis, Smith, 1926:48; 1943:453.— McCarthy, 1993:240.— David and Ineich, 1999:118.

Diagnostic characters.— Scales on thickest part of body with rounded or pointed tips, imbricate; 6–7 maxillary teeth behind fangs; normally 1 anterior temporal; 6–8 upper labials; 25–31 scale rows around neck, 33–38 around midbody (increase from neck to midbody 4–8); ventrals 295–362, distinct throughout, about twice as broad as adjacent body scales; yellowish or yellowish-green above, dorsal scales edged with black, 41–46 narrow black bands encircle body, the bands usually less than one-third the width of the lighter interspaces; head in young black with yellow horseshoe-shaped marking, in adult head usually yellow. Total length ♂ 1620 mm, ♀ 1830 mm; tail length ♂ 140 mm, ♀ 120 mm.

Hydrophis spiralis
From Fayrer (1874, pl. 21).

Hydrophis stricticollis
From Fayrer (1874, pl. 28).

Distribution.— Myanmar: coastal waters and tidal rivers. Elsewhere: Persian Gulf east to central Indonesia (Sulawesi) and north to the Philippines.

Habitat.— Little is known about the natural history of this species; it has been reported in deep water habitats (Ineich and Laboute 2002).

Hydrophis stricticollis Günther, 1864

Hydrophis stricticollis Günther, 1864:376, fig. (Type locality: India; Holotype: BMNH 1946.1.6.90).— Smith, 1926:73; 1943:459.— McCarthy, 1993:241.— David and Ineich, 1999:119.

Diagnostic characters.— Scales on thickest part of body subquadrangular or hexagonal in shape, feebly imbricate or juxtaposed; 8–11 maxillary teeth behind fangs; head small, body long and slender anteriorly, posteriorly 2.5 to 3 times thicker than anteriorly; 1 anterior temporal, rarely divided; 7–8 upper labials, second in contact with prefrontal, 3–4 border eye; 34–41 scale rows around neck, 45–55 around midbody; ventrals 374–452, distinct thoughout, less than twice as large as adjacent body scales; grayish to olive above, yellowish below, with 45–65 dark bands, widest dorsally, disappearing with age; head black or olive, yellow markings on snout and along sides of head. Total length ♂ 1050 mm, ♀ 1050 mm; tail length ♂ 140 mm, ♀ 90 mm.

Distribution.— Myanmar: coastal waters from Rakhine State south to Gulf of Martaban. Elsewhere: east coast of India from Orissa to Bengal, and Bangladesh.

Habitat.— Historic records exist for this species in rivers in the Bago Division (Smith 1926); however, not much is known about its habitat preferences.

Genus *Kerilia* Gray, 1849

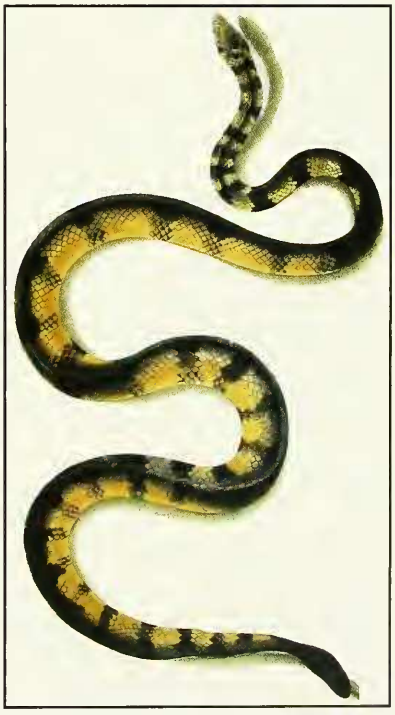
Kerilia Gray, 1849:57 (Type species: *Kerilia jerdoni* Gray, 1849).— Smith, 1926:31; 1943:446.

Kerilia jerdoni Gray, 1849

Kerilia jerdoni Gray, 1849:57 (Type locality: Madras, India; Holotype: BMNH III.8.1.a).— Smith, 1926:31, fig. 15; 1943: 447, fig. 143.— McCarthy, 1993:242.— David and Ineich, 1999:120.

Diagnostic characters.— Body subcylindrical, nearly uniform diameter throughout; scales keeled and imbricate, in 17–23 longitudinal rows, 17 on neck, 21–23 (19–21 for the Bay of Bengal) at midbody; head short; prefrontals usually not in contact with upper labials; 6 upper labials, 3–4 bordering eye; 1 pre- and 1 postocular; 1 large anterior temporal; ventrals 225–253 for the Bay of Bengal and Gulf of Siam (247–278 further east), small, distinct throughout, usually entire; olive above, yellowish or white below, with black dorsal spots of crossbars that form complete bands, especially in young. Total length 1000 mm, tail length 100 mm.

Distribution.— Myanmar: Tanintharyi Division (Mergui Archipelago). Elsewhere: east coast of India and Sri Lanka east to the Straits of Malacca, the east coast of Malaysia to Borneo.



Kerilia jerdoni. From Fayrer (1874, pl. 20).

Genus *Lapemis* Gray *in* Hardwicke and Gray, 1834

Lapemis Gray *in* Hardwicke and Gray, 1834, vol. 2, pl. 87, fig. 2 (Type species; *Lapemis hardwickii* Gray).

Remarks.— McDowell (1972) argued that he could not distinguish the genus *Thalassophina* Smith (1926) (type species, *Thalassophis viperina* Schmidt [1852]) from *Lapemis*. Although we believe that McDowell's views deserve serious consideration, again, as with *Enhydrina* (*q.v.*), we have taken the conservative approach and recognize *Thalassophina* as a distinct genus.

Lapemis hardwickii Gray *in* Hardwicke and Gray, 1834

Lapemis hardwickii Gray *in* Hardwicke and Gray, 1834, vol. 2, pl. 87 (Type locality: Penang, Malaysia; Holotype: BMNH 1946.1.18.39).— Smith, 1926:108, fig. 32, pl. 1, fig. 3; 1943:468, figs. 148–149.
Lapemis curtis hardwickii, McCarthy, 1993:244.

Lapemis hardwickii. (A preserved specimen; CAS-SU 12434.)

Diagnostic characters.— Body short, stout, neck region not less than half as thick at midbody; head large; scales squarish or hexagonal, juxtaposed, outer 3–4 rows larger than others, scale rows: ♂ 23–31 around neck, ♀ 27–35, around midbody, ♂ 25–27, ♀ 33–41; ventrals small, usually distinct anteriorly, not so posteriorly, in ♂ 114–186, in ♀ 141–230; head shields entire, parietals occasionally divided; nostrils superior, nasals in contact with one another; prefrontal usually in contact with second upper labial; 7–8 upper labials, 3–4 bordering eye; 1 pre- and 1–2 postoculars; 2, rarely 3, anterior temporals; greenish or yellow-olive above, whitish below, 35–50 olive to dark gray dorsal bars, tapering to a point laterally, occasionally encircling body, a narrow dark ventral stripe or broad irregular band occasionally present; adults often lack any pattern and are uniform olive to dark gray; head pale olive to black, yellow markings on snout present or not. Total length 860 mm, tail length 85 mm.

Distribution.— Myanmar (Map p. 460): coastal waters of the Tanintharyi Division (Mergui Archipelago). Elsewhere: southeast coast of India and the Straits of Malacca, east to Australia and north to China, Philippines, Taiwan, and Japan.

Habitat.— Known to be active during both day and night, this species is found to inhabit coral reefs; it also occurs in estuaries, and tidal zone regions with sandy or muddy bottoms (O'Shea 1996). It is usually found at depths of 6 to 15 m, but it has been encountered in deeper waters (O'Shea 1996).

Remarks.— Gritis and Voris (1990) do not recognize *L. hardwickii* as a distinct species, placing it in the synonymy of *L. curtis*. McCarthy (1993) recognizes it as a subspecies of *L. curtis*, allowing that the nominate form inhabits coastal waters from the Persian Gulf to the shores of western India, and *L. curtis hardwickii* ranges from the coastal waters of Sri Lanka and eastern India east to New Guinea and Australia and north to the coast of China, the Philippines, and Japan (see also David and Ineich 1999:121–122). Smith (1926:113, 1943:471) argues that *L. curtis* ranges from the Persian Gulf to the west coast of India as far as Sri Lanka but that it is unknown along the east coast of India. We have chosen to follow Smith's treatment of the two and recognize *L. hardwickii* as a distinct species.

Genus *Pelamis* Daudin, 1803

Pelamis Daudin, 1803:361 (Type species: *Pelamis bicolor* Schneider, 1799 [=*Anguis platura* Linnaeus, 1766]).

Pelamis platurus (Linnaeus, 1758)

Anguis platura Linnaeus, 1766:391 (Type locality: Unknown; Holotype: Unknown).
Pelamis platurus, Smith, 1926:116, fig. 33; 1943:476.— McCarthy, 1993:245.— David and Ineich, 1999:174.

Pelamis platurus. Photo by John Tashjian.

DIAGNOSTIC CHARACTERS.— Body compressed, posteriorly more than twice the diameter of the neck; body scales juxtaposed, subquadrangular in shape, in 49–67 rows around thickest part of body; ventral scales, 264–406, very small and, if distinct, divided by a longitudinal groove, but usually indistinguishable from adjacent body scales; head narrow, snout elongate, head shields entire, nostrils superior, nasal shields in contact with one another; prefrontal in contact with second upper labial; 1–2 pre- and 2–3 postoculars; 2–3 small anterior temporals; 7–8 upper labials, 4–5 below eye but separated from border by subocular; color variable but most often distinctly bicolored, black above, yellow or brown below, the dorsal and ventral colors sharply demarcated from one another; ventrally there may be a series of black spots or bars on the yellow or brown background, or the yellow may extend dorsally so that there is only a narrow middorsal black stripe, or a series of black crossbars (see Smith 1943:476–477 for a more complete description of the color pattern variants). Total length ♂ 720 mm, ♀ 880 mm; tail length ♂ 80 mm, ♀ 90 mm.

DISTRIBUTION.— The most widely distributed of all sea snakes ranging from the east coast of Africa throughout southern and eastern coastal Asia, as far north as southern Siberia, east throughout Indonesia to Australia and Tasmania. It is also known from the Gulf of Panama and north to Baja California in western North America, having arrived there probably during the interstadial, warm periods of the Pleistocene via a circum-Alaska route following the Japanese and California currents. Occasional strays have shown up in the Galapagos Archipelago to the south and in the Hawaiian Islands.

HABITAT.— Although primarily a pelagic species, it has also been found in bays and estuaries. Active during the day and night (O'Shea 1996).

Genus *Thalassophina* Smith 1926

Thalassophina Smith, 1926:33 (Type species: *Thalassophis viperina* Schmidt 1852).

REMARKS.— The correct name for this genus has been the subject of controversy for some years. Most recently, David and Ineich (1999:177) have argued that *Praescutata* is the proper name to use. The question arises because of uncertainty of just when the errata notice that accompanies Wall's original description of the genus was inserted into his publication, before or after distribution had begun. If before, then the work was "published" with the errata sheet, which becomes part of the original publication; if after some copies had been distributed, then David and Ineich's interpretation is justified. David and Ineich state that Wall's errata "was obviously written after the main part of the work, and later inserted in distributed copies." The question in not in when the errata

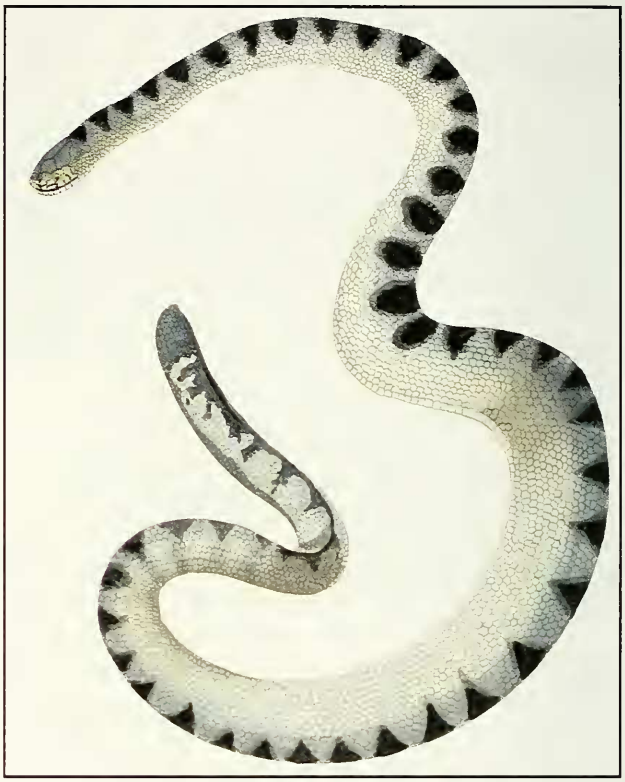
sheet was written or even printed, but when it was published, that is available for distribution. For the present, we choose to recognize *Thalassophina* as the valid name for the genus.

Thalassophina viperina (P. Schmidt, 1852)

Thalassophis viperina Schmidt, 1852:79, pl. 3 (Type locality: Java; Holotype: ZMH 404).
Thalassophina viperina, Smith, 1926:33, fig. 16.— McCarthy, 1993:247.
Praescutata viperina, Smith, 1943:448.— David and Ineich, 1999:177.

DIAGNOSTIC CHARACTERS.— Scales hexagonal, juxtaposed, in 27–34 rows on the neck, 37–50 at midbody; ventrals 226–274, anteriorly about half the width of the body, narrowing posterior to about twice the width of the adjacent scales, or slightly less; head shields entire, nostrils superior, nasal shields in contact with one another; prefrontals longer than broad, not in contact with upper labials; 1, rarely 2, pre- and 1–2 postoculars; 7–9 upper labials, 3–5 bordering eye (sometimes only 3–4 or 4–5); usually 1 anterior temporal, occasionally 2 or 3; body color, more or less bicolored, gray above, white below, the 2 usually clearly demarked on the sides, often with 25–35 dark rhomboidal spots, rarely with dark bands. Total length ♂ 925 mm, ♀ 820 mm; tail length ♂ 100 mm, ♀ 80 mm.

DISTRIBUTION.— MYANMAR: coastal waters. ELSEWHERE: Persian Gulf east to Gulf of Siam, southern China and Borneo.



Thalassophina viperina. From P. Schmidt, 1852, pl. 3.

FAMILY VIPERIDAE

Subfamily AZEMIOPINAE

Genus *Azemiops* Boulenger, 1888

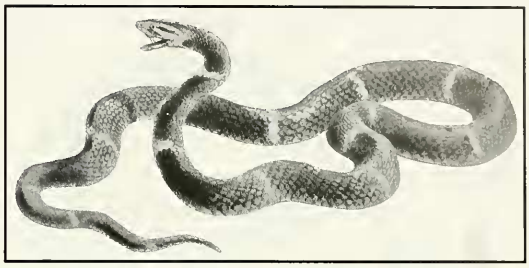
Azemiops Boulenger, 1888 (Type species: *Azemiops feae* Boulenger, 1888).

Azemiops feae Boulenger, 1888

Azemiops feae Boulenger, 1888:603, pl. 7 (Type locality: Kakhyen Hills, Burma; Holotype: MSNM 30891).— Smith, 1943:480, fig. 152.— Toriba, 1993:258.— Zhao and Adler, 1993:274.— David and Ineich, 1999:205— McDiarmid, Campbell, and Touré, 1999:230.— Mallow, Ludwig, and Nilson, 2003:14, pl. 1.1

DIAGNOSTIC CHARACTERS.— No sensory pit between nostril and eye; body cylindrical; head

flattened, above covered with large, symmetrical shields; nostril large, in single completely differentiated nasal; loreal shield present, small; 2 pre- and 2 postoculars; eye with vertically elliptic pupil; scales smooth, in 17 longitudinal rows at midbody; ventrals 180–189; subcaudals 42–53, mostly paired, occasionally anterior shields undivided; blackish above, scales often edged with gray, 14–15 narrow white or pinkish crossbands, sometimes interrupted middorsally, or alternating with one another laterally; head yellow with a pair of dark brown to black stripes of somewhat irregular width extending from prefrontals to the black color on the neck. Total length ♂ 925 mm, ♀ 820; tail length ♂ 100 mm, ♀ 80 mm.



Azemiops feae. From Boulenger, 1888, pl. 7.

Azemiops feae. Photo by John Tashjian.

Distribution.— Myanmar: Kachin State. Elsewhere: southern and central China (western Yunnan and Shaanxi east to Zhejiang and south to Guangxi), and northern Vietnam.

Habitat.— Although little is known about the natural history of this species, Kardong (1986) (summarizing Zhao and Zhao 1981) reports that it inhabits mountainous terrain at elevations between 1000-2000 m, but it has also been found in degraded habitats such as paddy, grassy fields and in and about villages. Historical records of this species in Myanmar indicate that it occurs in the Northern Triangle subtropical forest and the Nujiang Langcang Gorge's alpine-conifer and mixed-deciduous forest. For additional comments see Mallow et al. (2003).

Subfamily Viperinae

Genus *Daboia* Gray, 1842

Daboia Gray, 1842:69 (Type species: *Daboia elegans* Gray, 1842 [=*Vipera daboia* Daudin, 1803=*Coluber russelii* Shaw and Nodder, 1797], *fide* Smith, 1943:482).

Daboia russelii (Shaw and Nodder, 1797)

Coluber russelii Shaw and Nodder, 1797:291 (Type locality: India; Holotype: BMNH II.I.Ia).
Vipera russelli siamensis, Smith, 1917:223; 1943:484, fig. 153.
Daboia russelli siamensis, Toriba, 1993:268.
Vipera russellii, Zhao and Adler, 1993:278.
Daboia russelii, David and Ineich, 1999:312.— McDiarmid, Campbell, and Touré, 1999:371.— Mallow, Ludwig, and Nilson, 2003:150, pl. 7.2.

Diagnostic characters.— No sensory pit between nostril and eye; head very distinct from neck, above covered by small, keeled, imbricate scales, 6–9 between narrow supraoculars; nostril large, in large nasal shield which, below, is fused to the rostral; eye, with vertically elliptic pupil, surrounded by 10–15 small scales, 3–4 rows of small scales separating the circumocular scales from the upper labials; temporals small; 10–12 upper labials; 27–33 longitudinal rows of scales at

midbody, all except outmost row strongly keeled; ventrals 153–180; subcaudals 41–64, all paired; color above light brown with 3 longitudinal series of large black-margined brown spots or blotches, the vertebral series often merging to form a chain-like longitudinal stripe, occasionally an additional longitudinal series of small dark spots between vertebral and lateral series; yellowish white below occasionally with dark brown markings. Total length to 1600 mm are not uncommon (*fide* Smith 1943:484).

Daboia russelii. Photo by Hla Tun.

Distribution.— Myanmar (Map p. 461): Ayeyarwady Division, Bago Division, Magway Division, Mandalay Division, Sagaing Division, Shan State, Yangon Division. Elsewhere: southern China, Taiwan, India, Pakistan, Sri Lanka, Bangladesh, Thailand, Indonesia (Java east to Lomblen Island). Not reported from Malaysia or Sumatra.

Habitat.— Primarily inhabits lowland areas. It is common throughout the central dry zone and the Ayeyarwady delta and is often encountered in agricultural areas and paddies as well as open grasslands. Active at night.

Remarks.— Possibly the most common of the dangerously venomous snakes occurring in southern Asia, and responsible for more than half of all reported snakebites. Several color pattern variants have been recognized as distinct subspecies: *Daboia russelii siamensis* from southern China, central and southern Myanmar, and central Thailand; *D. r. formosensis* from eastern China and Taiwan; and the nominate form from India, Pakistan, and Bangladesh. Its unusual distribution, especially its erratic distribution in Indonesia, suggests it has been transported in the course of commercial exchanges, likely during the 18th and 19th centuries. *Daboia russelii* is a prolific breeder and young could easily have been transported among plants and other products that were frequently carried about during the early days of colonial expansion.

Arguments over the correct spelling of the species name, i.e., *russelii* versus *russellii*, abound to this day (most recently, see Adler et al. 2000:83, David and Ineich 1999:313, and McDiarmid, Campbell, and Touré 1999:370). The species was named for Patrick Russell, who spelt his name with a double "ll." However, there is no indication in the original publication by Shaw and Nodder, or any notice subsequently issued, that their use of the single "l" was a lapsus of any sort. Thus, we follow the original orthography despite the fact that the name of the person being honored is misspelled.

For extended comments on habitat, behavior, reproduction, bite and venoms, see Mallow et al. (2003).

Subfamily Crotalinae

Genus *Ovophis* Burger, 1981

Ovophis Burger *in* Hoge and Romano-Hoge, 1981:246 (Type species: *Trimeresurus monticola* Günther 1864).

Ovophis monticola (Günther, 1864)

Trimeresurus monticola Günther, 1864:388 (Type locality: Nepal and Sikkim; Syntypes: BMNH 1946.1.18.76 and 1946.1.19.91.— Pope, 1935:127, pl. 24D–E and 27A.— Smith, 1943:506, fig. 161.

Trimeresurus monticola monticola, Zhao and Adler, 1993:276.

Ovophis monticola monticola, Toriba, 1993:81.— Hallermann et al., 2002:152.

Ovophis monticola, McDiarmid, Campbell, and Touré, 1999:316.— David and Ineich, 1999:268.

Ovophis monticola. From Fayrer (1874, pl. 15).

Diagnostic characters.— Body stout; snout short, a little more than twice the length of the diameter of the eye; head covered above by small scales rather than large shields, scales usually smooth, feebly imbricate; first upper labial not fused to nasal, completely separated by a suture; body scales, smooth or weakly keeled, in 23–25, occasionally 19 or 21 longitudinal rows at midbody; supraoculars large, 5–9 scales in a line between them; internasals usually not in contact with one another, separated by 2 small suprapostrostral scales; 7–10 upper labials, second usually fused to the scale bordering the facial sensory pit anteriorly, fourth and fifth beneath eye but separated from orbit by 2–4 series of small scales; ventrals and subcaudals (Myanmar, northeastern India and adjacent areas of China and Thailand) 137–176 and 36–62 respectively, subcaudals mixed paired and single, occasionally all unpaired (ventrals and subcaudals for southern China, Vietnam, Laos: 127–144 and 36–54, and Malaysian Peninsula: 133–137 and 22–28 respectively [fide Smith 1943:509]). Total length ♂ 490 mm, ♀ 1100; tail length ♂ 80 mm, ♀ 150 mm.

Distribution.— Widely distributed from the eastern Himalayas, Myanmar (Map p. 461), southeastern Xizang (Tibet) and Yunnan, Thailand, southern China and Taiwan, to Vietnam, the Malaysian Peninsula to western Indonesia (Sumatra).

Habitat.— Found in the temperate and subtropical forests of northern Kachin State, from elevations around 1000 m. The altitudinal distribution throughout its range is reported between 700-2400 m (Schleich and Kästle 2002). Individuals have been found in leaf litter and shifting cultivation. Pope (1935) reports that this species is common around villages. Crepuscular (Schleich and Kästle 2002), also secretive and sluggish and most often found tucked away in piles of wood, logs, and rocks, also in rock crevices (David and Vogel 1966).

Remarks.— Zhao and Adler (1993:276) and Toriba (1993:82) recognize several subspecies, the westernmost populations from Nepal, northeastern India, Myanmar, and Yunnan and Szechwan Provinces of China as *Ovophis monticola monticola* (genus *Trimeresurus* in Zhao and Adler); *O. m. convictus* from Cambodia, Vietnam, Thailand, West Malaysia and western Indonesia; *O. m.*

Ovophis monticola (JBS 11879) from Kachin, Myanmar. Photo by Hla Tun.

makazayazaya from eastern China and Taiwan; and *O. m. zayuensis* from the type locality at Zayü Co, Xizang (Tibet), China. At this time, we take no position on the status of these taxa save that all are clearly members of a "*monticola*" species group.

Genus *Protobothrops* Hoge and Romano-Hoge, 1983

Protobothrops Hoge and Romano-Hoge, 1983:87 (Type species: *Trimeresurus flavoviridis* Hallowell, 1861).

Remarks.— In 1983, Hoge and Romano-Hoge described the new genus *Protobothrops* to accommodate two species previously placed in the genus *Trimeresurus, Trimeresurus jerdonii* and *T. mucrosquamatus*. Since that time, few authors have followed their recommendation. More recently, however, Kraus et al. (1996) indicated that preliminary DNA studies support its recognition, though, as pointed out by McDiarmid et al. (1999:329), it was done with some reservation. McDiarmid et al. (*loc. cit.*), thus, chose to take a more conservative approach, pending further studies, and treated *Protobothrops* as a synonym of *Trimeresurus*. In the same year, David and Ineich (1999:274), also citing Kraus et al., as well as additional but unpublished data (received from N. Vidal), decided to recognize *Protobothrops* as a valid genus, though they did note that "the limits of this genus remain provisional." Of the eight trimeresurid species David and Ineich refer to *Protobothrops*, three occur in Myanmar, *P. jerdonii, P. kaulbacki*, and *P. mucrosquamatus*. In this report, we have chosen to follow David and Ineich's classification scheme.

Protobothrops jerdonii (Günther, 1875)

Trimeresurus jerdonii Günther, 1875:233, pl. 34 (Type locality: Khasi Hills, India; Syntypes: BMNH 196.1.18.66–68).— Pope, 1935:409, pl. 25.— Smith, 1943:510, fig. 162.— Toriba, 1993:100.— David and Tong, 1997:26, 28.— McDiarmid, Campbell, and Touré, 1999:336.

Protobothrops mucrosquamatus, Hoge and Romano-Hoge, 1983:86.— David and Ineich, 1999:275.— David, Captain and Bhatt, 2001:224

Diagnostic characters.— Scales in 21 longitudinal rows at midbody (rarely 23); snout length a little more than twice diameter of eye; head above, except for large internasals and supraoculars, covered by small, unequal, smooth scales that are feebly imbricate or juxtaposed; first labial completely separated from nasal by a suture; internasals separated by 1–2 small scales; 6–9 small scales in line between supraoculars; 7–8 upper labials, third and fourth beneath eye, in contact with subocular or separated by at most a single series of small scales; ventrals (see Remarks below): ♂ 164–188, ♀ 167–193; subcaudals: ♂ 50–78, ♀ 44–76. Total length ♂ 835 mm, ♀ 990 mm; tail length ♂ 140 mm, ♀ 160 mm.

Distribution.— Myanmar (Map p. 461): Chin State (Chin Hills), Kachin State. Elsewhere:

Protobothrops jerdoni. Variation in color pattern (CAS 215115 [left] and CAS 215015 [right]). Both individuals from Yunnan Province, China. Photos by Dong Lin.

India (Assam), China (Yunnan, Szechwan, Hupeh).

Habitat.— This species has been recorded in Myanmar and adjacent areas in Yunnan, from elevations of 1442 m to just under 2300 m. In Nepal it has been recorded as high as 2800 m (Schleich and Kästle 2002). Historical records from the Chin Hills and Kachin State as well as recent records from Kachin State place this species in montane (Chin Hills-Rakhine Yoma) and temperate (Northern Triangle) forests. Individuals have been found in shifting cultivation. Orlov et al. (2001) report this species (albeit a different subspecies) as commonly found along rocky streams in trees, shrubs, and under rocks.

Remarks.— Both Pope (1935:409) and Smith (1943:510) took note of the distribution of ventral and subcaudal counts among their samples in relation to their geographic origins. Smith, in particular, notes the following: "Burma, Yunnan (17 examples): V. ♂ 164–173, ♀ 167–189; C. ♂ 50–55 (69), ♀ 44–61. Burma-Tibet border (12 examples): V. ♂ 181–188, ♀ 184–193; C. ♂ 67–78, ♀ 64–76, paired." Elsewhere in its range, Maslin (1942) chose to recognize the populations from eastern and southeastern China as a distinct subspecies, *Trimeresurus jerdonii xanthomelas* Günther, and Klemmer (1963) referred the populations from Vietnam and Cambodia to *Trimeresurus jerdonii bourreti*. Toriba (1993:100) recognizes both and assigns the remaining populations from Myanmar, northeastern India and the Yunnan and Xizang region of China to the nominate subspecies. The interesting distribution of ventral and subcaudal counts recorded by Smith, apart from the clear indication of sexual dimorphism, suggests the Myanmar-India-southwestern Chinese populations deserve further careful study.

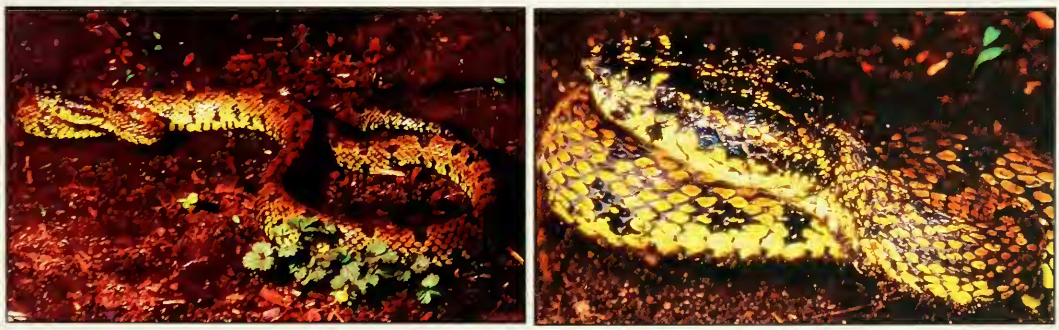
Protobothrops kaulbacki (M.A. Smith, 1940)

Trimeresurus kaulbacki Smith, 1940:485, pl. 8, fig. 5 (Type locality: Pangnamdim, north of the Triangle, Upper Burma; Holotype: BMNH 1946.1.19.23–24); 1943:512.— Toriba, 1993:101.— McDiarmid, Campbell, and Touré, 1999:337.

Protobothrops kaulbacki, Kraus, Mink, and Brown, 1996:769.— David and Ineich, 1999:276.

Diagnostic characters.— Scales in 23–25 longitudinal rows at midbody; body elongate, head long, massive, with narrow snout; canthus rostralis sharp; single large, squarish loreal; first upper labial completely separated from nasal by a suture; second upper labial anteriorly bordering facial pit; 8–10 scales in line between supraoculars; supraoculars usually single, flat, without a vertical projection; dull grayish or olive green with large, blackish rhombohedral dorsal blotches, either distinct or united to one another; smaller spots on sides; symmetrical yellow lines on head; subcaudals paired; ventrals 201–212; subcaudals 66–78, some of the anterior scutes may be single, others paired; hemipenes with spines. Total length ♂ 1340 mm, ♀ 1410 mm; tail length ♂ 225 mm, ♀ 230 mm.

Distribution.— Myanmar (Map p. 461): Kachin State (Pangnamdim).



Protobothrops kaulbacki. Photos by Hla Tun.

Habitat.— Little is known of the habitat preferences of this rare snake. The lone individual of this species from recent work was found at the type locality (Pangnamdin) at an elevation of 1015 m. This region falls at the transition zone between temperate Northern Triangle forests and eastern alpine shrub and meadow.

Protobothrops mucrosquamatus (Cantor, 1839)

Trigonocephalus mucrosquamatus Cantor, 1839:32 (Type locality: Naga Hills, Assam, India; Holotype: Unknown; original description probably based on colored drawing [no. 18] in Bodleian Library, Oxford).
Trimeresurus mucrosquamatus, Swinhoe, 1870:411, pl. 31.— Pope, 1935:416, pl. 26.— Smith, 1943:507.— Toriba, 1993:102.— McDiarmid, Campbell, and Touré, 1999:339.
Protobothrops mucrosquamatus, Hoge and Romano-Hoge, 1983:86.— David and Ineich, 1999:276.

Protobothrops mucrosquamatus. Photo by Hla Tun.

Diagnostic characters.— Scales in 25 longitudinal rows at midbody; scales on upper surface of head, small, each scale keeled posteriorly; internasals 5–10 times size of adjacent scales, separated by 3–4 scales; supraoculars, long, narrow, undivided, 14–16 small interocular scales in line between them; 2 scales on line between upper preocular and nasal; 9–11 upper labials, first upper labial separated from nasal by suture; 2–3 small scales between upper labials and subocular; 2–3 rows of temporal scales above upper labials smooth, above those scales keeled; ventrals 200–218; subcaudals 76–91, all paired; grayish or olive brown above, with dorsal series of large brown, black-edged spots or blotches, and a lateral series of smaller spots; head above brownish, below whitish; belly whitish but heavily powdered with light brown; tail brownish (possibly pink in life [fide Smith 1943:507]), with series of dark dorsal spots; hemipenes spinose. Total length ♂ 1122 mm, ♀ 1160; tail length ♂ 195 mm, ♀ 205 mm.

Distribution.— Myanmar (Map p. 461): Kachin State Elsewhere: northeastern India and Bangladesh, China, Taiwan and northern Vietnam.

Habitat.— Found in the Northern Triangle temperate and subtropical forests of Kachin State at elevations of 250–1088 m. Individuals have been found near streams either under rocks or in the leaf litter. Pope (1935) reports that the species is common in hilly and mountainous areas. In Vietnam, Orlov et al. (2001) state that the species is common around villages and disturbed habitat. Active at night.

Genus *Trimeresurus* Lacépède, 1804

Trimeresurus Lacépède, 1804:209 (Type species: *Vipera viridis* Daudin, 1803 [=*Coluber gramineus* Shaw, 1802]).

Remarks.— See remarks under Genus *Protobothrops*.

Trimeresurus albolabris Gray, 1842

Trimeresurus albolabris Gray, 1842:48 (Type locality: China; Holotype: BMNH 1946.1.19.85).— Smith, 1943:523, fig. 166 [map].— David and Ineich, 1999:280.— McDiarmid, Campbell, and Touré, 1999:329.
Trimeresurus albolabris albolabris, Toriba, 1993:95.— David and Tong, 1997:25–26.

Diagnostic characters.— Scales in 21 (rarely 19) longitudinal rows at midbody;

Trimeresurus albolabris. Photo by Hla Tun.

10–11(12) upper labials, the first partially or completely fused to the nasal; head scales small, subequal, feebly imbricate, smooth or weakly keeled; supraoculars narrow, occasionally enlarged, undivided, 8–12 interocular scales between them; temporal scales smooth; green above, side of head below eyes yellow, white or pale green, much lighter than rest of head; below, green, yellowish or white below, a light ventrolateral stripe present in all males, absent in females; end of tail not mottled brown; ventrals: ♂ 155–166, ♀ 152–176; subcaudals: ♂ 60–72, ♀ 49–66, paired; hemipenes without spines. Total length ♂ 600 mm, ♀ 810; tail length ♂ 120 mm, ♀ 130 mm.

Distribution.— Myanmar (Map p. 462): north of 13°N. Elsewhere: India (Assam), Thailand, Cambodia, Laos, Vietnam, China, Malaysia, western Indonesia (as far east as Sulawesi).

Habitat.— Often found in heavily degraded forest, or in agricultural areas. Documented to occur in moist mixed deciduous, and subtropical forests (both Northern Triangle and Northern Indochina) as well as temperate forests. This species is commonly encountered in bamboo stands, although individuals have also been found on trees, in bushes, on the ground in open fields, and crossing roads. Elevations range from 60–751 m in Myanmar, although it is recorded as high as 3050 m in Nepal (Schleich and Kästle 2002). Active at night. David and Vogel (1996) note that it prefers lowland habitats, both forested and open, and when in bushes or trees, usually within 2 or 3 m of the ground.

Remarks.— Two subspecies have been described, *T. a. insularis* Kramer (1977) from eastern Indonesia (Soe and Timor) and *T. a. septentrionalis* Kramer (1977) from Nepal and northwestern India (Simla).

Trimeresurus erythrurus (Cantor, 1839)

Trigonodactylus erythrurus Cantor, 1839:31 (Type locality: Ganges Delta; Holotype: BMNH 1946.1.19.99).
Trimeresurus erythrurus, Smith, 1943:386, fig. 165.— Toriba, 1993:97.— David and Ineich, 1999:283.— McDiarmid, Campbell, and Touré, 1999:331.

Trimeresurus erythrurus. Photo by Dong Lin.

Diagnostic characters.— Scales in 23–25 longitudinal rows at midbody; first upper labial partially or completely fused to nasal; 9–13 upper labials, 1–2 rows of scales separate upper labials from subocular; 11–14 scales in a line between supraoculars; supraoculars rarely divided; temporal scales small, strongly keeled; ventrals: males 153–174, females: 151–180; subcaudals: ♂ 62–79, ♀ 49–61, usually paired, occasionally unpaired shields present among paired series; head uniform green, dorsum bright green, light ventrolateral stripe present in males, present or absent in females (Maslin [1942:23] says that the ventrolateral stripe is absent, but Smith [1943:524] states that it is present in males and variable in females), tail spotted with brown; hemipenes without spines. Total length ♂ 575 mm, ♀ 1045; tail length ♂ 120 mm, ♀ 165 mm.

Distribution.— Myanmar (Map p. 462): Sagaing State, Kachin State, Rakhine State, Yangon Division. *T. erythrurus* is found west of Long. 98°. Elsewhere: India (northeastern India from Bengal to Assam, east of Long. 88°) east through Bangladesh.

Habitat.— Individuals of this species have been found in rainforests (Myanmar coastal, Mizarom-Manipur-Kachin) and moist deciduous forest. Elevations are recorded under 200 m. Individuals have been met with in trees and on the ground near streams. Active at night.

Trimeresurus medoensis Zhao, 1977

Trimeresurus medoensis Zhao in Zhao and Jiang, 1977:66, pl. 2, fig. 9, 1–5 (Type locality: near Ani Bridge, Motuo, Xizang, at 1200 m; Holotype: CIB 73-II-5208).— Toriba, 1993:103.— McDiarmid, Campbell, and Touré, 1999:339.— David and Ineich, 1999:287.— David et al., 2001:218.— David, Captain and Bhatt, 2002:210–226, figs. 1–7.

Diagnostic characters.— Scales in 17 longitudinal rows at midbody, dorsal rows 7–11 slightly keeled; 8 upper labials, first upper labials separated from nasals by a distinct suture; green or bluish green above, yellowish white below, the two separated by a bright bicolored red (below) and white (above) ventrolateral stripe (in both males and females), which occupies the whole of the outermost scale row and a portion of the second row; ventrals less than 150; hemipenes short, thick, spinose. Total length ♂ 671 mm, ♀ 650; tail length ♂ 125 mm, ♀ 115 mm.

Trimeresurus medoensis. Photo courtesy Ashok Captain.

Distribution.— Myanmar (Map p. 462): Kachin State (Naung Mon, Rainbow Village, Myitkina; Alangdunhku). Elsewhere: China (Xizang Autonomous Region); India (Arunachal Pradesh) (after David et al. 2001:218; David et al. 2002:210 ff.).

Habitat.— The only records of this species in Myanmar are from Kachin State. Three specimens from Nam Ti Valley are referenced in the original description (Zhao 1977), and their identifications are confirmed by David et al. (2001). A specimen from the Mytkina area is also referable to this species (David et al 2001). David et al. (2001) and Das (2002) report this snake as frequenting bamboo stands in otherwise evergreen forest. The lone specimen from recent collections made by members of the Myanmar survey team was found near a trail in low elevation evergreen forest that was interspersed with bamboo stands where the forest had been altered. Active at night (Das 2002).

Trimeresurus popeiorum M.A. Smith, 1937

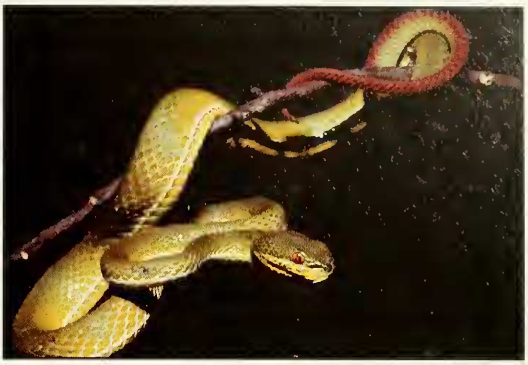
Trimeresurus popeiorum Smith, 1937:730 (Type locality: Sikkim, India; Holotype: BMNH 72.4.17.137.— David and Ineich, 1999:288.— David, Captain, and Bhatt, 2002:218, 223.

Trimeresurus popeorum, Smith, 1943:518.— Toriba, 1993:103.— McDiarmid, Campbell, and Touré, 1999:340.

Trimeresurus popeiorum popeiorum. David et al., 1997:27.

Diagnostic characters.— Scales in 21 (rarely 23) longitudinal rows at midbody; 9–11 upper labials, first upper labials separated from nasals by a distinct suture; a single supraocular;

above green, below pale green to whitish, the two separated by a bright bicolored orange or brown (below) and white (above) (males) or white (females) ventrolateral stripe, which occupies the whole of the outermost scale row and a portion of the second row; ventrals 155–169; subcaudals 52–76, in males the base of the tail enlarged to the level of subcaudals 20–25; hemipenes long and slender, smooth, without spines. Total length 770 mm, tail length 170 mm.



Trimeresurus popeiorum. Photo by John Tashjian.

Distribution.— Myanmar (Map p. 462): Bago Division, Mon State, Tanintharyi Division, and (?)Chin State. Elsewhere: Laos; Vietnam; Cambodia; Malaysia; Singapore; Indonesia (Kalimantan, Sumatra), (?) Thailand (see David et al. [2001:218]).

Habitat.— In Peninsular Malaysia and Singapore, this nocturnal species is reported from montane forests (Lim and Lee 1986) with elevations from 900–1500 m (Cox et al. 1998). Elsewhere, it has been found in hilly areas with wet forest (David and Vogel 1996). In Myanmar, it has been found in low elevation (less than 500 m) montane and coastal rainforest. Individuals have been collected on tree limbs overhanging streams and in bushes. Active at night.

Remarks.— Most often confused with *T. stejnegeri* (*q.v.*), the two have quite distinct hemipenes, which does not make identification of individuals in the field or in the laboratory any easier without recourse to (a) male individuals and (b) an examination of the hemipenes. However, the two species are not known to have overlapping distributions, at least based on available materials. Also, closely allied to *T. popeiorum* is *T. yunnanensis* (*q.v.*); ordinarily, the two are more easily be told apart by the number of midbody scale rows, 21 in *T. popeiorum*, 19 in *T. yunnanensis*.

The species name "*popeiorum*" has been variously spelt "*popeiorum*" and "*popeorum*." In the original description, it was given as "*popeiorum*," but in 1943, in the footnote on p. 518, Smith states "*Popeiorum* as originally spelt is a clerical error." Although a clerical error, yet the use of "*popeorum*" contravenes Article 32(c)(ii), which states that an original spelling is an 'incorrect original spelling' if "there is in the original publication itself, without recourse to any external source of information, clear evidence of an inadvertent error . . . (. . . and use of an inappropriate connecting vowel are not to be considered inadvertent errors)." Because there is no such evidence in the original publication, *Trimeresurus popeiorum* must stand as the appropriate spelling for the nominal species meant to honor Clifford H. Pope.

Trimeresurus purpureomaculatus Gray, 1830

Trigonocephalus purpureomaculatus Gray *in* Gray and Hardwicke, 1830:pl. 81 (Type locality: Singapore; Holotype: BMNH 1946.1.19.54 and Hardwicke's sketch no. 158).

Trimeresurus purpureomaculatus purpureomaculatus, M.A. Smith, 1943:520.— Toriba, 1993:104.

Trimeresurus purpureomaculatus, David and Ineich, 1999:280.— McDiarmid, Campbell, and Touré, 1999:42.

Diagnostic characters.— Scales in 25–27 longitudinal rows at midbody; 11–13 upper labials, the first partially or completely united with the nasal; supraocular very narrow, sometimes broken into small scales, 12–15 scales between them; head scales small, subequal, tuberculate or granular; temporal scales keeled; body color highly variable, above olive, grayish, to dark purplish brown, below whitish, greenish or brown, uniform or spotted with brown; a light line on scale row

one bordering ventrals present or absent; head olive, heavily suffused with brown; ventrals: ♂ 160–179, ♀ 168–183; subcaudals: ♂ 74–76, ♀ 56–63, paired; hemipenes without spines. Total length ♂ 665 mm, ♀ 900; tail length ♂ 125 mm, ♀ 140 mm.

Trimeresurus purpureomaculatus. Photo by Dong Lin.

Distribution.— Myanmar (Map p. 462): Ayeyarwady Division, Mon and Karen States south of Lat. 17°N, Tanintharyi Division. Elsewhere: Malaysia, Singapore, western Indonesia (Sumatra).

Habitat.— This species has been found in abundance in the remaining mangrove forests of the Ayeyarwady Delta. Lim and Lee (1986) similarly report this species from mangrove forests on offshore islands and mainland peninsular Malaysia and Singapore. David and Vogel (1996) report that in Sumatra it is found in mangrove and coastal swamp habitats, in marshes, and along canals and river banks. Individuals have been found in trees and shrubs. Crepuscular.

Remarks.— A population of Asian pit vipers that is closely allied to *T. purpureomaculatus* occurs on the Andaman and Nicobar Islands. In 1868, Theobald described it as a new species, *T. andersoni*. Since then it has been variously treated as a synonym of *T. purpureomaculatus* or as a subspecies of the latter. In view of its complete isolation from mainland *T. purpureomaculatus* and its distinguishing features (see Smith 1943:520–521), we take the position that it is best treated as a distinct species. We do recognize that it was derived from a population of *T. purpureomaculatus* that inhabits a neighboring area, but which of the neighboring areas we do not know.

Trimeresurus stejnegeri K.P. Schmidt, 1925

Trimeresurus stejnegeri K.P. Schmidt, 1925:4 (Type locality: Shaowu, Fukien, China; Holotype: AMNH 21054).— Pope, 1935:409, pl. 25.— Smith, 1943:517.— McDiarmid, Campbell, and Touré, 1999:344.— David and Ineich, 1999:290.— David, Vidal and Pauwels, 2001:205, 218, 221.— David, Captain and Bhatt, 2002:218, 221, 223.— Hallermann et al., 2002:152.

Trimeresurus stejnegeri stejnegeri, Maslin, 1942:22.— Toriba, 1993:105.

Diagnostic characters.— Scales in 21 longitudinal rows at midbody; 9–11 upper labials, first upper labials separated from nasals by a distinct suture; a single narrow supraocular, sometimes divided by transverse suture; 11–16 scales in a line between supraoculars; above bright to dark green, below pale green to whitish, the two separated by a bright bicolored orange or brown (below) and white (above) (males) or bicolored or white only (females) ventrolateral stripe, which occupies the whole of the outermost scale row and a portion of the second row; ventrals 150–174, subcaudals 54–77 (but see David et al. [2002:218 and 2001:215] for geographic distribution of these data), all paired; hemipenes short, spinose beyond bifurcation. Total length 750 mm, tail length 145 mm.

Distribution.— All records of this species from Myanmar have been referred to *Trimeresurus yunnanensis* (see below). Elsewhere: China (central and southeastern), Taiwan, Vietnam. For possible northeast Thailand occurrence, see David et al. (2001:218–219).

Habitat.— Pope (1935) reports that this nocturnal species is very common around fast-flowing streams. Elevations are recorded from 500–900 m (*ibid.*).

Remarks.— See remarks under *T. yunnanensis* (below).

Trimeresurus yunnanensis K.P. Schmidt, 1925

Trimeresurus yunnanensis K.P. Schmidt, 1925:4 (Type locality: Tengyueh [=Tengchiong Co.], Yunnan, China; Holotype: AMNH 21058).— David and Tong, 1997:26–27.— David and Ineich, 1999:294.— David, Vidal and Pauwels, 2001:218.— David, Captain and Bhatt, 2002:218, 221, 223.

Trimeresurus stejnegeri, Smith, 1943:517 (part).

Trimeresurus stejnegeri yunnanensis, Maslin, 1942:22.— Toriba, 1993:106.

Diagnostic characters.— Scales in 19 (rarely 21) longitudinal rows at midbody and 19(–21) on neck; 9–10 (rarely 11) upper labials, first upper labials separated from nasals by a distinct suture; a single narrow supraocular, sometimes divided by transverse suture; 11–16 scales in a line between supraoculars; above bright to dark green, below pale green to whitish, the two separated by a bicolored orange or brown (below) and white (above) (males) or white only or absent (females) ventrolateral stripe, which occupies the whole of the outermost scale row and a portion of the second row; ventrals 155–165 (–170); subcaudals (58–) 61–68, all paired; hemipenes short, spinose beyond bifurcation. Total length 750 mm, tail length 145 mm.

Distribution.— Myanmar (Map p. 462):Chin State (Haka); Kachin State. Elsewhere: China (Anhui, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Sichuan, Yunnan, Zhejiang); Taiwan; Vietnam (Lao Cai, Vinh Phú, and possibly Bac Thai, Da Nang, Gia Lai, and Hoa Binh); Laos (after David et al. 2001:218).

Habitat.— Recorded at 1206 m in the mountainous regions of Yunnan in Nujiang Langcang Gorge alpine conifer and mixed forest. Das (2002) (as *T. stejnegeri*) reports this species at elevations up to 2845 m. Historical records for Myanmar place this species in subtropical forests (northern triangle) and Chin Hills-Rakhine montane forest. Individuals have been recorded in bushes and trees and on the ground in grass (Pope 1935), also from grassy slopes with shrubs as well as mixed forest (Schleich and Kästle 2002).

Remarks.— This species has been variously treated as a subspecies of *T. stejnegeri* and as a distinct species allied to *T. stejnegeri*. David et al. (2001) have referred all specimens previously identified as *T. stejnegeri* coming from Myanmar to *T. yunnanensis*, and they have restricted *T. stejnegeri* to China, Taiwan, Vietnam and Laos. A specimen identified as *T. stejnegeri* in the Natural History Museum London, reportedly from Chin State, is considered by David et al. to be "an atypical specimen of *T. yunnanensis*" (David et al. 2001:219). If David et al. are correct, then *Trimeresurus stejnegeri* should probably be removed from the faunal list for Myanmar, although the "*stejnegeri*" clade is still represented in the country by *T. yunnanensis* and *T. medoensis* (*q.v.*). Nonetheless, as we pointed out earlier (p. 409), there is a good possibility that *T. stejnegeri* (*sensu stricto*) will turn up in eastern Shan and Kachin States,[4] and for this reason, it is still listed here (see above). On the other hand, we also concur with David et al. (2001:219) who argue, with justification, that considerable work remains to be done and material examined from throughout the southern ranges (from northeastern India to Vietnam) of the several recognized nominal species to understand species boundaries within the "*stejnegeri*" clade.

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Note: Not included in this section are full bibliographic citations for most pre 20th century literature even though reference is made to them in the synonymies (e.g., Schneider, 1799, 1801; Cantor, 1839; Gray, 1834, 1842, 1849; Laurenti, 1768; Linnaeus, 1758, Schmidt, 1925, and others). Complete citations to these will be found in the bibliography in Golay et al. 1993 (*q.v.*).

[4] N.B. Hallermann et al. (2002) identified one of Leonardo Fea's specimens collected at "Mti. Carin [=Karen], 900–1000 m a.s.l. (ZMH R06267-8)" (Kayah State) as *T. stejnegeri*. Kayah State is immediately south of Shan State.

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APPENDIX A

SNAKEBITE PROCEDURES IN MYANMAR

Prepared by Joseph B. Slowinski, Ph.D.

NOTICE: A word of caution. The following guidelines were formulated from recommendations made in the WHO/SEARO Guidelines for the Clinical Management of Snakebites in the Southeast Asian Region (1999), written and edited by Dr. David Warrell, and from specific comments made by Dr. David Warrell. However, recommendations and medical procedures undergo constant review and revision; thus, the reader is cautioned to seek the latest information and guidance from appropriate medical specialists before adopting any of the recommendations cited below.

In case of a bite from any species in the family Elapidae or Viperidae or a bad bite from a *Rhabdophis subminiatus*, the bitten person must be transported to a hospital as soon as possible. Do not allow traditional treatments; they will only delay transport to the hospital and can even cause additional damage. Although a bite from a venomous snake should be considered a medical emergency, the victim should be reassured and calmed as much as possible. During the transport process to the hospital, the victim should move as little as possible—any muscle contractions will increase systemic absorption of the venom. With treatment, the chances of dying from a venomous snakebite are small.

The best hospital has the following:

1) antivenom;
2) epinephrine to treat anaphylaxis;
3) a system for assisted breathing in the case of neurotoxicity from an elapid bite;
4) treatment for acute kidney failure.

Russell's viper (*Daboia russelii*). Do not apply first aid, do not allow the patient to walk, proceed immediately to a hospital and request antivenom for *Daboia russelii* from the Myanmar Pharmaceutical Industry. Severe systemic symptoms such as incoagulable blood, hemorrhage, shock, and kidney failure can develop rapidly from bites by this species. At the hospital, blood coagulability should be tested, which can be done by the 20-minute whole blood clotting test (see below). The hospital should be prepared to treat the kidney failure that often results from bad bites by this species.

Monocled cobra (*Naja kaouthia*). Do not apply first aid, do not allow the patient to walk, proceed immediately to a hospital and request antivenom for *Naja kaouthia* from the Myanmar Pharmaceutical Industry. If breathing becomes difficult because of severe neurotoxicity—whether or not antivenom has been administered—the patient should be placed on assisted breathing. Neuromuscular transmission can often be dramatically improved with an anticholinesterase drug such as neostigmine or edrophonium. Atropine should be given as well.

Spitting cobra (*Naja mandalayensis*). Do not apply first aid, do not allow the patient to walk, proceed immediately to a hospital. Do not accept antivenom. If breathing becomes difficult because of severe neurotoxicity (this species may or may not cause neurotoxicity; there is no published information on the clinical effects of its venom), the patient should be placed on assisted breathing. Neuromuscular transmission can often be dramatically improved with an anticholinesterase drug such as neostigmine or edrophonium. Atropine should be given as well. There is anecdotal evidence that the venom of this species can cause severe local effects, including necrosis.

In the case of spitting cobra venom spat in the eyes, the eyes should be immediately flushed with generous amounts of water. Do not accept the traditional treatment of tamarind leaf juice in the eyes. Apply topical antibiotic unless corneal abrasions can be excluded by fluorescein staining or slit lamp examination.

King cobra (*Ophiophagus hannah*). Apply a compression bandage to the bitten limb, do not allow the patient to walk, proceed immediately to a hospital. Do not accept antivenom, unless they have antivenom specifically made for king cobras in India or Thailand. If breathing becomes difficult because of severe neurotoxicity—whether or not antivenom has been administered—the patient should be placed on assisted breathing. Neuromuscular transmission can often be dramatically improved with an anticholinesterase drug such as neostigmine or edrophonium. Atropine should be given as well.

Elapid seasnake (*Hydrophis, Lapemis*, other genera). Apply a compression bandage to the bitten limb, do not allow the patient to walk, proceed immediately to a hospital. Do not accept antivenom. If breathing becomes difficult because of severe neurotoxicity, the patient should be placed on assisted breathing. Neuromuscular transmission can often be dramatically improved with an anticholinesterase drug such as neostigmine or edrophonium. Atropine should be given as well. Note: local symptoms from bites by this group may be minimal and should not be taken as a sign of no envenomation.

Krait (*Bungarus*). Apply a compression bandage to the bitten limb, do not allow the patient to walk, proceed immediately to a hospital. Do not accept antivenom. If breathing becomes difficult because of severe neurotoxicity, the patient should be placed on assisted breathing. Neuromuscular transmission can often be dramatically improved with an anticholinesterase drug such as neostigmine or edrophonium. Atropine should be given as well. Note: local symptoms from bites by this genus may be minimal and should not be taken as a sign of no envenomation.

Coral snake (elapid genera *Maticora* (= *Calliophis*), *Calliophis, Sinomicrurus*). Do not

apply first aid, do not allow the patient to walk, proceed immediately to a hospital. Do not accept antivenom. If breathing becomes difficult because of severe neurotoxicity, the patient should be placed on assisted breathing. Neuromuscular transmission can often be dramatically improved with an anticholinesterase drug such as neostigmine or edrophonium. Atropine should be given as well.

Vipers (other than *Daboia*) (*Ovophis, Protobothrops, Trimeresurus*). Any viperid other than the Russell's viper (e.g., *Trimeresurus*). Do not administer first aid; proceed immediately to a hospital, do not accept antivenom.

Red-necked keelback (*Rhabdophis subminiatus*). If the bite was bad (i.e., the snake chewed the skin for more than several seconds), do not administer first aid, proceed immediately to a hospital, do not accept antivenom. The blood should be tested for incoagulability. Note: the bad symptoms from this species may take more than a day to develop.

Antivenom Rules

1) Antivenom should only be administered if there are signs of local or systemic envenomation.

2) Before antivenom is injected, epinephrine must be available to counter anaphylaxis. If the need arises to inject epinephrine, an antihistamine should also be applied to neutralize histamine release during the allergic reaction.

3) Under no conditions should you allow antivenom from a species other than the one that bit the victim to be administered.

4) Under ordinary circumstances, do not accept antivenom made in other countries, except possibly in case of a bad king cobra bite.

5) The doctor should monitor the patient for adverse reactions for at least one hour after antivenom is administered.

Definitions and Explanations

20-minute whole blood clotting test. A very simple test to perform. Place a few ml of blood into a glass container; leave undisturbed for 20 minutes; tip the vessel once. If the blood is still liquid and runs out, the patient has incoagulable blood, a sign of systemic poisoning.

Anaphylaxis. A potentially life-threatening allergic reaction to foreign molecules characterized by a dramatic drop in blood pressure. With snakebite, anaphylaxis can develop in two ways: in response to the venom or in response to the antivenom. When antivenom is administered it is important for the hospital to have epinephrine nearby to counteract a possible anaphylactic reaction.

Neurotoxicity. The venoms of cobras, kraits, and sea snakes are dominated by neurotoxins, compounds that adversely affect the nervous system. Symptoms of neurotoxic poisoning include loss of muscle control, which often is manifested by drooping eyelids and loss of muscle tone in other facial features. The major effect — and the deadly one — is the paralysis of the diaphragm resulting in the inability to breathe. This is the reason for the necessity of assisted breathing mechanisms.

Antivenom. Antivenom is generally manufactured in horses. A large dose of antivenom causes the body to react to the serum and so severely that the body's immunological reaction is so strong as to cause shock and possibly death from the antivenom. Epinephrine counteracts the immunological reaction and reduces shock. Antivenom is dangerous for the reason described above and is highly species specific. Taking an antivenom for another snake species has no medical value

because it will not counteract the venom of a different species, and it threatens the snakebite victim because of the potential immunological reaction to the serum. The antivenoms produced in Myanmar use venom from Myanmar snakes. Because the venoms from the same species in different geographic areas may differ, it is essential that you use Myanmar antivenoms to ensure that the antivenom works to counter the venom injected by a Myanmar species. The Myanmar Pharmaceutical Industry manufactures antivenom against bites from Russell's vipers and monocled cobras.

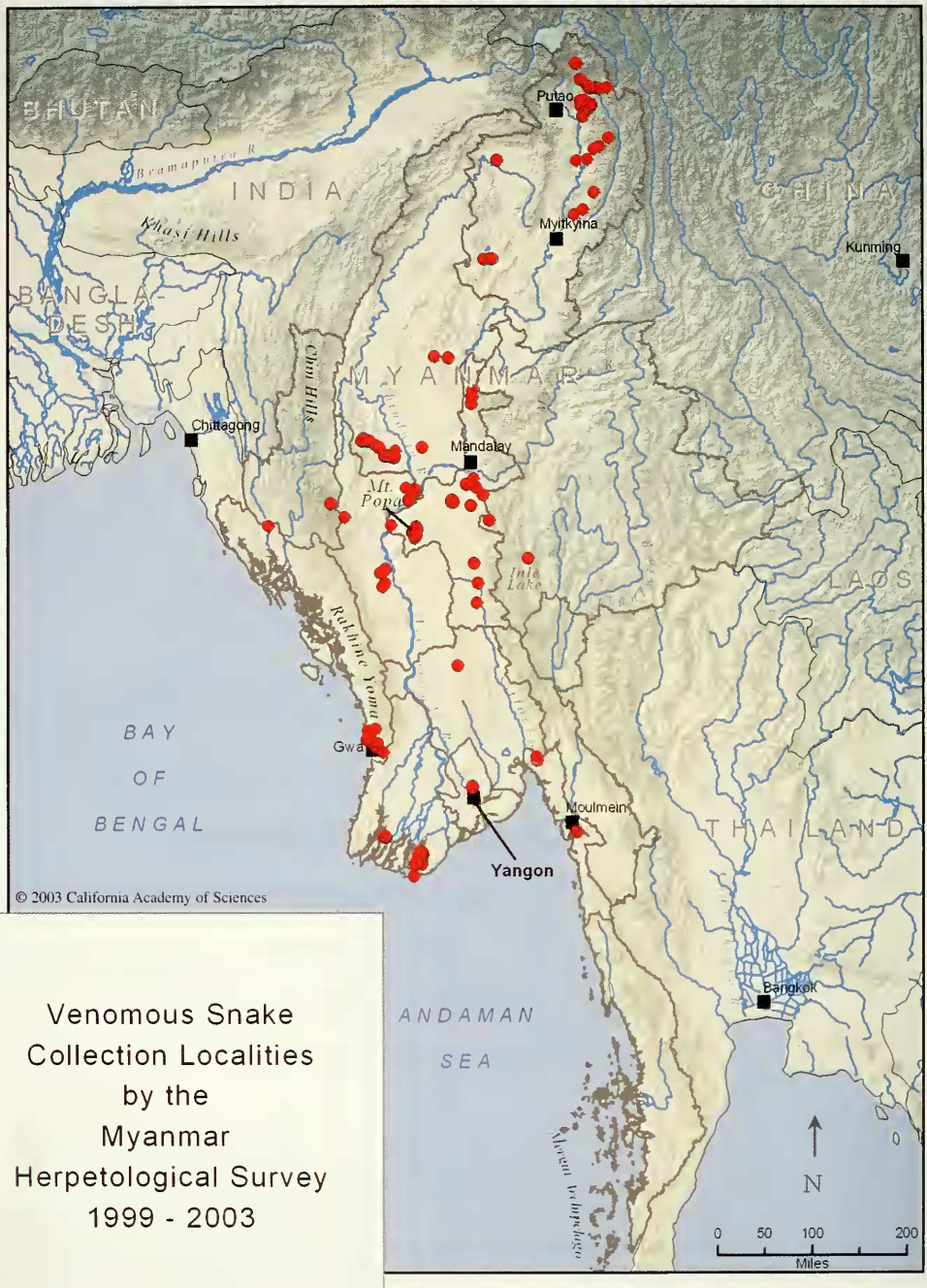
Compression bandage. The above recommendations for and against the use of compression bandages are based on a consideration of a venom's potential to cause local tissue damage versus its potential to cause life-threatening systemic symptoms. A compression bandage should be applied as tightly as for a sprained ankle. It should not be applied so tightly that it eliminates the bitten limb's pulse. A compression bandage applied to a bitten limb will retard the venom's absorption by the body, but traps venom in that compartment running the risk of amplified local tissue damage. The venom of kraits is known to be highly toxic, yet does not cause serious local tissue damage. Hence, there is little risk of tissue damage by applying the bandage, only the benefit of retarding venom spread until a hospital is reached. On the other hand, the venom of snakes of the genus *Trimeresurus* have the potential to cause severe local tissue damage, which will be made much worse by the application of a compression bandage.

* *

MAPS
Locations of dangerously venomous snake materials collected by Myanmar Herpetological Survey teams 1999–2003 with additional localities taken from literature records

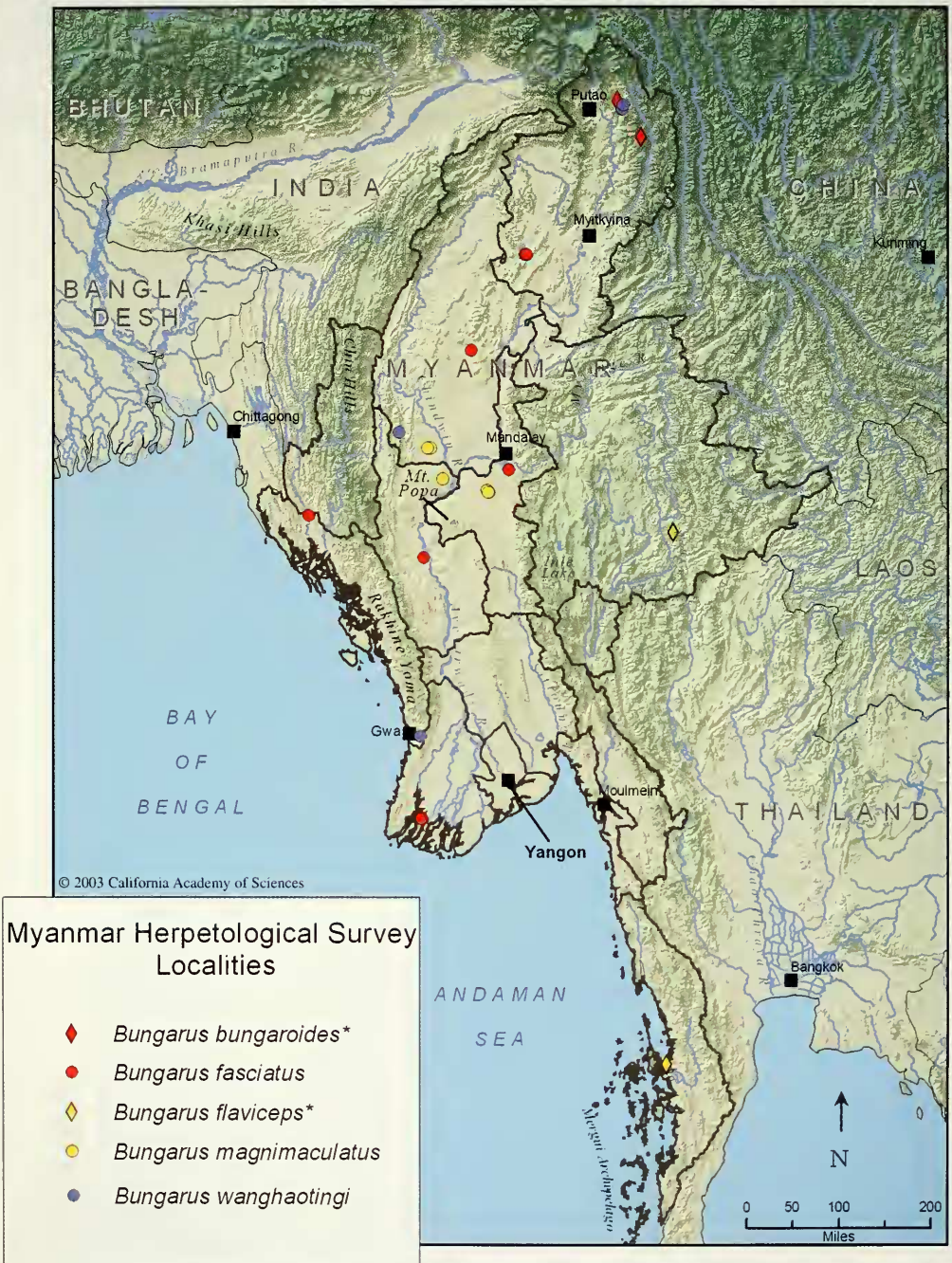
Note: Maps are digitally rendered using ArcGIS® (ESRI) and source material from U.S. Geological Survey (USGS), National Imagery and Mapping Agency (NIMA), and Australian Centre of the Asian Spatial Information and Analysis Network (ACASIAN). Inspiration for the Myanmar Ecosystem map came from reading Olson, David M., et al. 2001. Terrestrial ecoregions of the World: A new map of life on Earth. *BioScience* 51(11).

All maps were prepared by Michelle S. Koo, Biogeographic Information Systems Manager, Department of Herpetology, California Academy of Sciences



Venomous Snake Collection Localities by the Myanmar Herpetological Survey 1999 - 2003

Ecoregions of Myanmar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OF
BENGAL
Gwa
Moulmein
Yangon
THAILAND
Bangkok
ANDAMAN
SEA
Mergui Archipelago
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Myanmar Herpetological Survey
Localities
Bungarus bungaroides*
Bungarus fasciatus
Bungarus flaviceps*
Bungarus magnimaculatus
Bungarus wanghaotingi
* locality from literature; see checklist.
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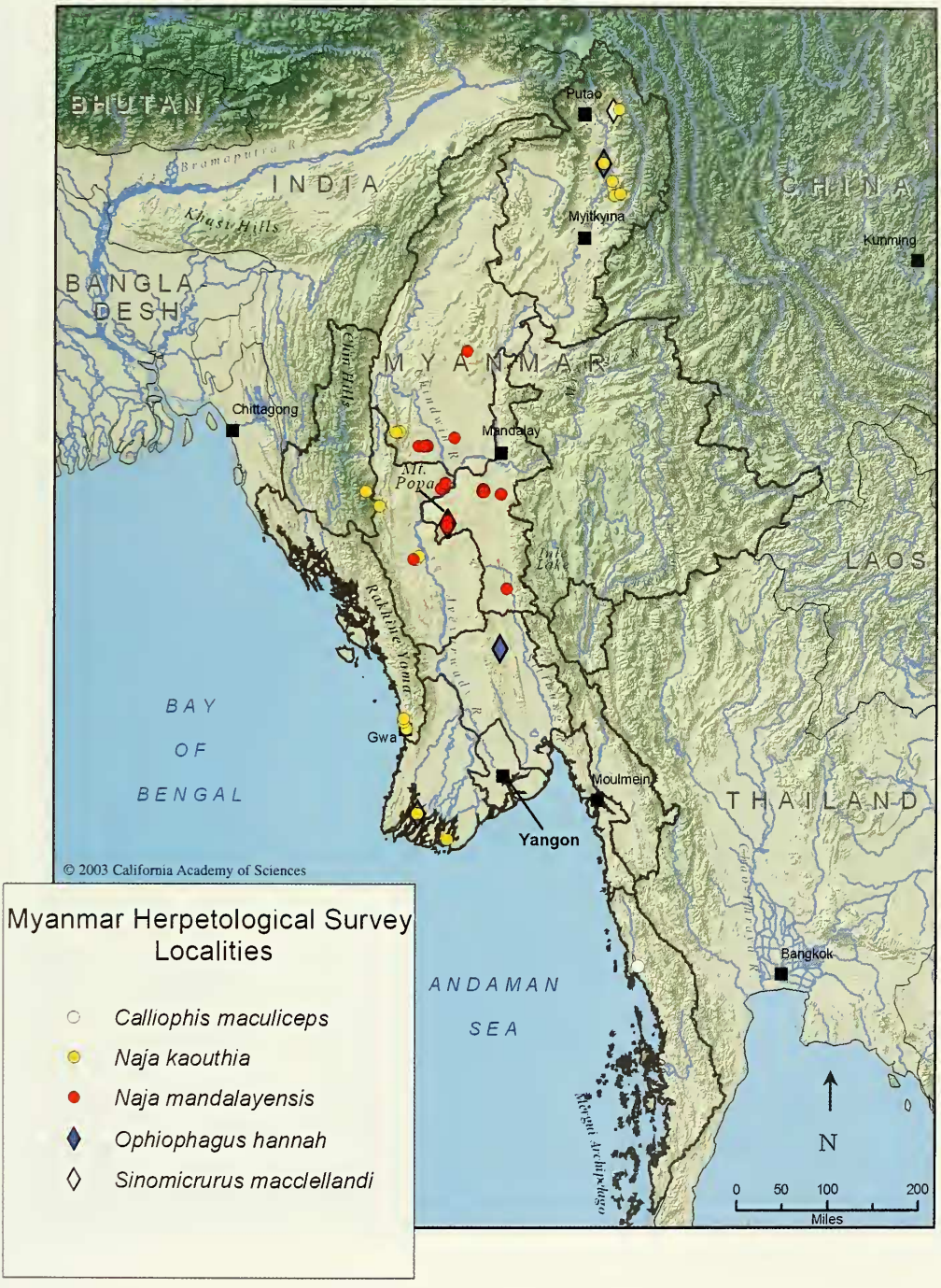
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Yangon
Bangkok
Khasi Hills
Chin Hills
Rakhine Yoma
Mergui Archipelago
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Myanmar Herpetological Survey Localities
Calliophis maculiceps
Naja kaouthia
Naja mandalayensis
Ophiophagus hannah
Sinomicrurus macclellandi
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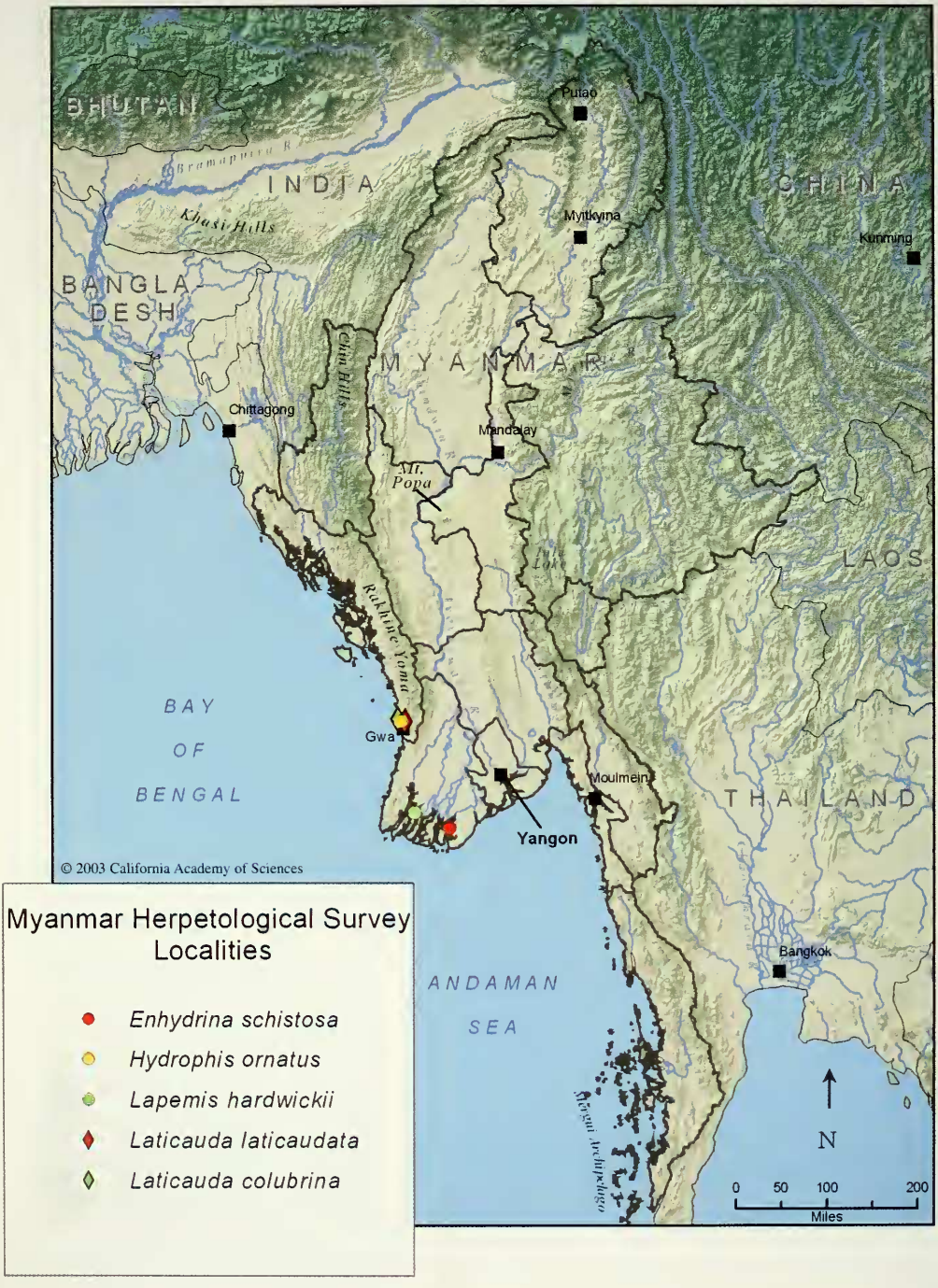
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BENGAL
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Yangon
THAILAND
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Myanmar Herpetological Survey Localities
Enhydrina schistosa
Hydrophis ornatus
Lapemis hardwickii
Laticauda laticaudata
Laticauda colubrina
Bangkok
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SEA
Mergui Archipelago
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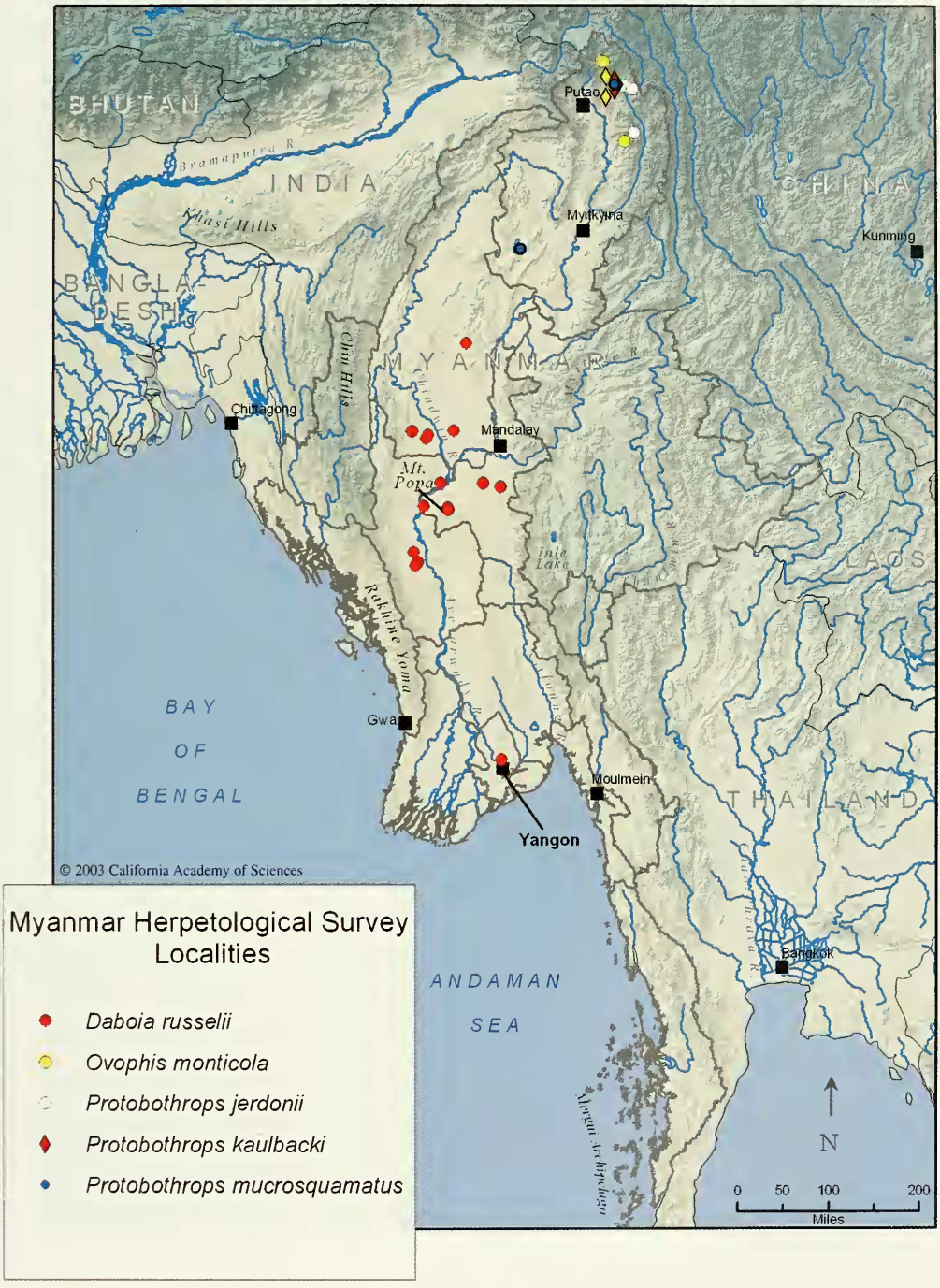
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Andaman Archipelago
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Myanmar Herpetological Survey Localities
Daboia russelii
Ovophis monticola
Protobothrops jerdonii
Protobothrops kaulbacki
Protobothrops mucrosquamatus
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